

The Chemical Age

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Industrial Chlorine

THE chlorine industry may be said to have been born, or at least conceived, in 1799 when Tennant discovered bleaching powder, at which period chlorine was produced by the action of MnO_2 on HCl . There is a tradition, we do not know whether the evidence is stronger than that, that liquified chlorine was first obtained by Northmore in 1805, but most authorities give the credit to Faraday who on March 5, 1823, was experimenting with chlorine hydrate in a sealed tube. A visitor, Dr. Paris, noting some oily matter in the tube, chaffed Faraday upon the use of dirty apparatus. When the tube was opened for cleaning, its contents exploded and the oil disappeared. On repeating the experiments next day, Faraday again produced the oil which he identified as liquid chlorine—another example of a chance discovery leading to the ultimate foundation of industrial enterprise. So far as we know, it was not until 1888, however, that the Badische Anilin produced liquid chlorine commercially by direct compression using a piston of sulphuric acid. Two years later the electrolytic production of chlorine from salt solutions was solved by Griesheim Elektron and to-day electrolytic chlorine is the standard article of commerce. The process used for liquefaction is either direct compression and cooling, refrigeration, or a combination of the two. The general industrial use of compressed gases naturally led to the engineering problem of the provision of a suitable container, and there was a gradual evolution from the elementary type of riveted cylinders to the modern type, hot-punched from the billet and drawn hot or cold.

Much useful information upon the method of handling chlorine containers, as well as upon other subjects connected with compressed chlorine, was given by Mr. F. Holt in a paper read before the Chemical Engineering Group on January 10. One of the most striking features of the information contained in Mr. Holt's paper is the divergence of official opinion as shown by the regulations in force in various countries. The essentials for safety, as laid down by Mr. Holt, are a container of adequate strength and prevention of over-filling. The filling ratio is one point upon which there is general agreement, the regulations quoted for six of the greatest industrial countries being 1.25, a figure which is based upon 6 per cent. free space at temperatures of 45°C . As an indication of the differences of opinion that exist regarding cylinder strength it is of interest to note that this country tests for home service to 1,280 lb./sq. in., the United States to 5/3rds the service pressure, *i.e.*, to about 500 lb., Germany and Holland to twice the working pressure,

which seems to be covered by a test pressure of 330 lb., while Japan specifies 375 lb., and Belgium 427 lb. In general, provision for records which provide a complete history of each container from the analysis of the original cast of steel to the date of scrapping is essential.

In the use of chlorine containers the salient facts are the rapid rise of pressure with temperature and the rapid corrosion of steel by chlorine when access of moisture is allowed. A general precaution is the need for cleanliness since foreign materials may react with chlorine, giving rise to bursting pressures. It is naturally essential to determine from time to time the quantity of chlorine left behind in a container, and it is surprising to hear from Mr. Holt's account that in some quarters the pressure in the cylinder is considered sufficient indication. Since chlorine is liquefied in the cylinders, it must be obvious that the pressure can only be that of the vapour pressure of the chlorine at the particular temperature obtaining. The cylinder must be weighed to ascertain the amount of chlorine in it. It would be impossible here to discuss all the valuable guidance that Mr. Holt gives for handling the various apparatus in which chlorine is used or conveyed—cylinders, drums, tank wagons, storage tank, and pipe lines. In general these precautions are based on a few principles, and given a clear understanding of the chemical and physical nature of liquid chlorine, the rules laid down follow naturally. One of these principles is that nothing should be done to cause any unnatural rise of temperature. Another is the avoidance of all extraneous impurities in the container which may cause explosions through chemical action resulting in generation of gases. A third principle is the exclusion of moisture—even compressed air used to facilitate the expulsion of chlorine from tanks must be dried by calcium chloride—because of the rapid corrosion of steel by moist chlorine. All vessels must have adequate safety devices to prevent over-filling, and pipe-lines must not be left filled with liquid chlorine; this being explained by its high coefficient of expansion. Finally, care should be taken to ensure that chlorine containers should not be allowed to fall from even a moderate height, such as off a lorry. Mr. Holt does not explain the necessity for this last precaution, and we are not altogether clear why it should be insisted upon in view of the high factor of safety in British chlorine containers. The essential condition for the safe handling of this and other dangerous liquids is that those responsible should understand the chemistry and physics of the substances they use.

Notes and Comments

The Congress and Plant Exhibition

PRELIMINARY time-tables and lists of papers to be presented at the Chemical Engineering Congress of the World Power Conference in London from June 22 to 27 will be in the hands of those who have intimated their desire to participate within the next few days. The various committees are getting busy and the congress promises to rank equally in importance with all the sectional conferences that have preceded it. Preparations are also proceeding well in connection with the chemical plant exhibition to be held simultaneously with the congress. Only two such exhibitions have been held in this country before, one in 1926 and one in 1931, and the progress in chemical plant since the last show has been so striking that most of the exhibits at Westminster next June will be entirely new. With some twenty countries taking part in the congress, the British plant maker will have a unique opportunity of showing the world what he can do, and he will have only himself to blame if he allows our overseas visitors to go away unconvinced that he is capable of supplying the plant needs of the industry in all parts of the world.

The British Industries Fair

TWENTY-FOUR miles of exhibits will be seen at the British Industries Fair to be held simultaneously in London and Birmingham, February 17 to 28. The stand frontage in London will be $12\frac{1}{2}$ miles and that in the heavy section at Birmingham will be $11\frac{1}{2}$ miles. The chemical industry will, as usual, have a section of its own at Olympia which promises to be rather larger than in 1935, owing to the inclusion of two or three new exhibitors. The arrangements for the section, which is one of seven showing an increase, are being made by the Association of British Chemical Manufacturers. The 1936 Fair, taken as a whole, will be a record-breaking event. The overseas catalogue issued last week-end, gives details of the exhibits at Olympia and in the furniture and textiles section at the White City, and carries as an inset an advance list of exhibitors at Birmingham, many of whom are closely associated with the production of chemical plant. Most of the foreign buyers visiting the Fair will come from Holland. Germany is second on the list, a position occupied last year by Belgium, which is third in the 1936 order as calculated by the number of buyers who have already announced their intention of coming to Britain. Large contingents of buyers will also arrive from France, Denmark, Switzerland, the United States, Norway, Sweden, Poland, Czechoslovakia and Spain. The Empire country sending the largest number of buyers is the Irish Free State; Canada comes next, followed by India, South Africa and Australia in that order. Sixty-four countries in all will be represented.

Cancer-Causing Chemicals

THE discovery of chemical carcinogenic agents has been the outcome of the recognition of the cancer-producing properties of coal tar, shale oil, and mineral lubricating oils. This action, suspected from the prevalence of skin cancer among workers handling these materials, was first demonstrated experimentally by

Yamagiwa and Ichikawa in 1915. Following the pioneer work of Bloch, and of Kennaway, and guided by the fluorescence spectrum technique of Mayneord, the isolation from coal tar of a potent carcinogenic hydrocarbon, 1:2-benzpyrene, and its synthesis were effected in 1932 by Cook, Hewett and Hieger. According to Professor J. W. Cook, D.Sc., F.I.C., of the Cancer Hospital Research Institute, London, who read a paper before the local Section of the Society of Chemical Industry at the Institute of Chemistry, at Manchester, on January 10, this hydrocarbon is related to 1:2-benzanthracene, and is one of a whole group of compounds derived from 1:2-benzanthracene which have been shown to have cancer-producing properties of varying degrees of potency. From the standpoint of molecular structure the more outstanding features are (a) the constancy with which carcinogenic activity is exhibited by benzanthracene derivatives with substituents at positions 5 or 6, or both, (b) the sensitivity to relatively slight modifications of structure such as the introduction or withdrawal of a methyl group, or alteration of the position of substitution, and (c) the existence of carcinogenic compounds not related to 1:2-benzanthracene.

Step Towards Better Understanding

METHYLCHOLANTHRENE, a benzanthracene hydrocarbon formed by reactions of a biochemical type from two of the bile acids, cholic acid and deoxycholic acid is the most active carcinogenic compound yet examined. Methylcholanthrene, the structure of which was proved by Cook and Haslewood, has been prepared synthetically by Fieser and Saligman; and on its structural relationship to the bile acids is based the hypothesis that the onset of cancer in man in some cases may be due to abnormal degradation to a cancer-producing chemical compound of a substance normally present in the body. The experimental investigation of this hypothesis is unlikely to produce spectacular "cancer cures," but may reasonably be hoped to lead to a better understanding of the factors responsible for the onset of malignant disease. The biological researches of Lacassagne, Burrows and others have shown that although the hormone, oestrone, has no carcinogenic action comparable with that of the chemical carcinogenic agents already mentioned, yet its application may lead in certain circumstances to cancerous tumours in a few cases, and in other circumstances to conditions which are regarded by some authorities as providing a basis for subsequent tumour growth. In this connection the relationship of the carcinogenic hydrocarbon, 1:2:5:6-dibenzanthracene, to some of the synthetic oestrus-producing agents is of interest. This work showed that this carcinogenic hydrocarbon could be transformed, by the introduction of hydroxyl and alkyl groups, coupled with partial hydrogenation, into compounds which show in a very high degree the manifold biological activities characteristic of the natural hormone, oestrone. These results suggest that, conversely, it might be possible by suitable modification of oestrone to convert it into other compounds in which the hormonal function becomes less pronounced and the possible neoplastic action more predominant. So far this has not been achieved.

New Scientific Instruments and Apparatus

Annual Exhibition Organised by the Physical Society

THE 26th annual exhibition of scientific instruments and apparatus, organised by the Physical Society, was held at the Imperial College of Science and Technology, South Kensington, London, January 7-9. Eighty-four firms exhibited in the trade section, and contributors to the research and experimental section were 29 in number. As usual, there was also a section for apprentices and learners, with the object of encouraging craftsmanship and draughtsmanship in the scientific instrument trade.

At the stand occupied by the Bausch and Lomb Optical Co., Ltd., there was an attachable colorimeter lamp which can be fitted to any B. and L. colorimeter, the light intensity being adjustable and evenly balanced from a source of one bulb. The lamp operates direct from any ordinary circuit and it is properly ventilated to prevent hot air currents reaching the operator's face.

Vacuum-Jacketed Fractionating Column

The G.L.C. vacuum-jacketed fractionating column, exhibited by Griffin and Tatlock, Ltd., is a highly efficient fractionating column made of Pyrex glass, having a Dufton type metal spiral contained in a tube enclosed in a silvered, hard-exhausted vacuum jacket. Separations which have been almost theoretical, of, for example, a mixture of benzene, toluene and *m*-xylene, have been accomplished by means of this column. It has been developed particularly for the analysis of benzoles, although it has other uses. For use in the analysis of small samples, the distillation "flask" is contained in the vacuum jacket and is wound with resistance wire connected through tungsten seals by which connection to the heater is made. In a second type the distillation "flask" is attached to the column by means of a standard ground glass joint.

A new accurate type of gas specific gravity balance, which is portable, self-contained and rapid in action, was also shown by Griffin and Tatlock, Ltd. This balance has been designed to operate on small quantities of gas and a determination can be carried out with less than 200 ml. of gas in from 3 to 5 min. The apparatus consists of two hemispherical glass shells enclosing an almost spherical glass bulb to which a light beam, pivoted on an agate knife edge, is attached. The beam is graduated and provided with riders which, in the zero positions, bring the system into equilibrium when the spherical interspace contains air at N.T.P. A second set of graduations on the beam and an appropriate rider give the gas factor by which readings are multiplied to reduce to N.T.P. In use, the desired gas is led into the interspace and the difference in upthrust on the inner bulb is counter-balanced by movement of the upper set of riders.

Charles Hearson and Co., Ltd., exhibited an electrically driven air pump for pressures up to $1\frac{1}{2}$ atmospheres and a vacuum up to 600 mm. mercury, capacity (compressed or suction air) being up to 11 litres per minute. This firm were also showing the "Telespeed" analytical balance, an improved type of balance with chain action, but fitted with aperiodic device and projected reading unit.

Air-Driven Ultra Centrifuge

The most interesting exhibit at the stand of Baird and Tatlock (London), Ltd., was an air-driven ultra centrifuge. This machine is made on the principle devised by M. M. Henriot and Haynenard and modified by Professor McIntosh. Speeds up to 60,000 r.p.m. are attainable, the relative centrifugal force at this speed being of the order of 300,000 times the normal gravitational force.

Another new exhibit by Baird and Tatlock, Ltd., was the "I.C.I. Ltd." gelatine clarity tester. The clarity is measured in terms of the light transmitted by a 4 per cent. gel through

a 2 in. cell, expressed as a percentage of the light transmitted through a similar cell containing dust-free distilled water. The transmitted light is arranged to impinge on a photoelectric cell, and the current excited measured by a microammeter. In use cells containing gelatine and water respectively are placed successively in position in the instrument and the ratio of the current obtained expressed as a percentage is the clarity of the gelatine. Although primarily designed for testing gelatine this instrument may be used for measuring the clarity of other materials.

Micro-Orsat gas analysis apparatus was also shown by Baird and Tatlock, Ltd. The case of the two element pattern measures only $12\frac{1}{4}$ in. \times $6\frac{1}{2}$ in. \times $3\frac{1}{2}$ in. The burette reads directly in percentages and is calibrated in a novel way to correct the volume for draught or partial vacuum in the flue while the sample is being taken. A built-in draught gauge may be readily connected with the flue by means of a three-way stopcock.

Electrically-Heated Furnaces

Electrically-heated furnaces, with simplified automatic thermostatic control gear, were shown by A. Gallenkamp and Co., Ltd. This new control is much simpler and cheaper than the previous patterns available and gives control which is amply accurate enough for most purposes. Retort stand clamps of a new pattern in die-cast aluminium alloy with cadmium plated screw parts which will hold firmly any article between $1/16$ in. and $3\frac{1}{2}$ in. diameter were also shown. The aluminium parts can be anodised, thus making the clamp exceptionally corrosion proof.

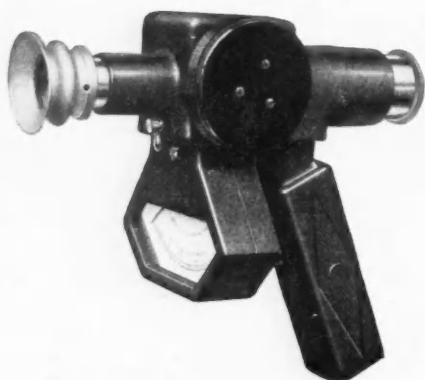
At the stand occupied by The Thermal Syndicate, Ltd., there was a range of alumina laboratory ware. This new product, 99.9 per cent. Al_2O_3 , is refractory and resistant to many fused metals, oxides and compounds, and is suitable for physico-metallurgical and ceramic work up to $1,950^\circ$ C.

Negretti and Zambra were showing a new automatic recording type controller for low pressures. This instrument, in conjunction with suitable valves, dampers or other controlling gear, may be used to maintain constant air or gas pressure in tunnels, ducts or similar plant. Another useful application is the control of small heads of liquid. Ordinary pressure controllers are frequently found to be insufficiently sensitive for such purposes.

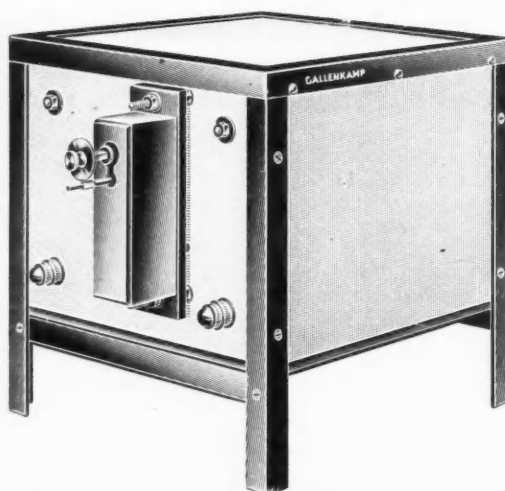
Multiway Cocks

Multiway cocks for light pressures, intended primarily for use with instruments for indicating or recording light pressures, such as pressure or draught gauges, tank gauges, etc., were also exhibited by Negretti and Zambra. These cocks can be supplied with any number of "ways" up to seven, enabling a single instrument to be connected as required, to any one of a number of pressure lines. The cocks are constructed throughout of brass, the "plug" consisting of a disc, the face of which is kept in contact with a fixed annular leather washer in which are punched from one to seven holes. These multiway cocks are provided with a flanged base for mounting them on a bench or on the front of a panel. The provision of two clamping screws renders the cocks suitable for "flush panel mounting."

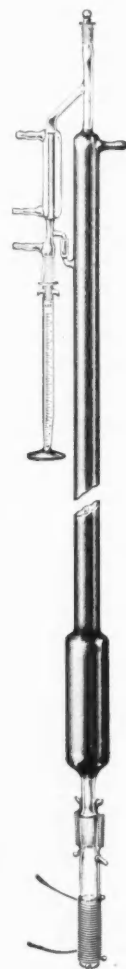
In the projection refractometer shown by Bellingham and Stanley, Ltd., the border line is projected upon a scale, and is thus read without any eyepiece or magnifying system. The material to be tested—which may be opaque—is placed upon the horizontal face of a prism. This, being the only optical part of the instrument exposed, is easily and rapidly cleaned. A small internal lamp, taking 1 watt, produces the necessary illumination, and can be operated from a mains transformer if a.c. is available, or a small dry battery. As the lamp



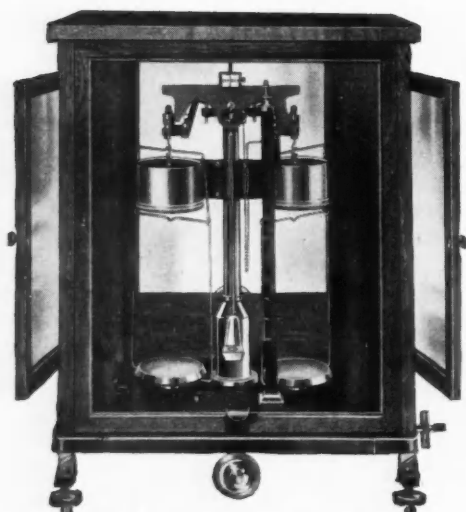
Optical Pyrometer of Disappearing
Filament Type.
(The Foster Instrument Co., Ltd.)



Electric Furnace with Simplified Automatic
Thermostatic Control Gear.
(A. Gallenkamp & Co., Ltd.)



The G.L.C.
Vacuum-Jacketed
Fractionating
Column.
(Griffin & Tatlock, Ltd.)

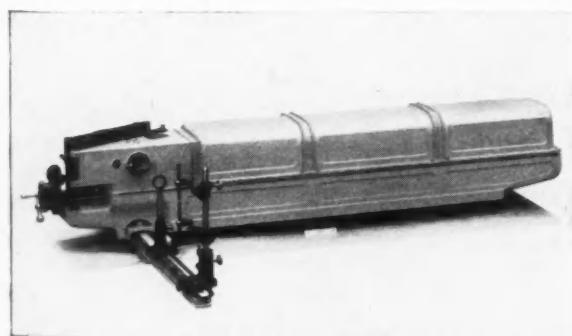


The "Telespeed" Analytical Balance.
(Charles Hearson & Co., Ltd.)

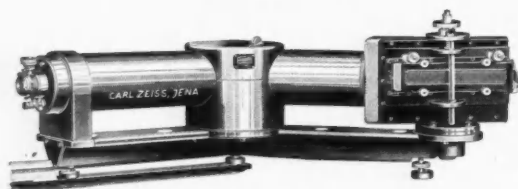
New Instruments and Apparatus at the Physical Society's Annual Exhibition



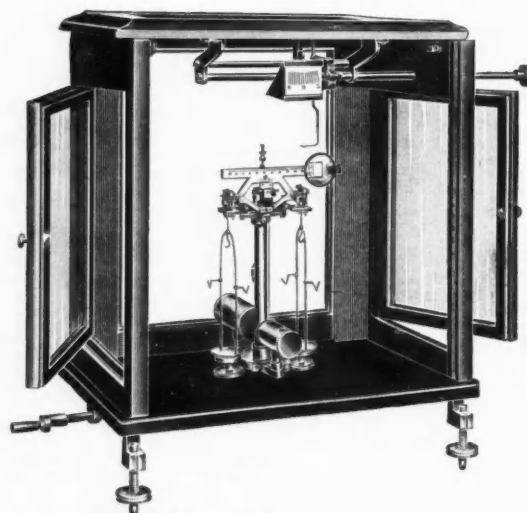
Projection Refractometer.
(Bellingham & Stanley, Ltd.)



Fully Automatic Quartz Spectrograph
(Adam Hilger Ltd.)



Quartz Spectrograph.
(Carl Zeiss, London, Ltd.)



Prismatic Reflecting Micro Balance.
(L. Oertling Ltd.)

operates at $3\frac{1}{2}$ volts, there is no risk of shock to the operator in handling the instrument. The prism system is designed to give an achromatic border line for sugar solutions from 30 to 90 per cent. soluble solids, and a filter is provided to deal with other materials. Adjacent to the sugar scale is a scale of refractive indices covering the range from 1.3820 to 1.5165.

A thermoelectric temperature regulator for use up to $1,400^{\circ}\text{C}$. was shown by The Gas Light and Coke Co., in conjunction with a small gas-heated muffle furnace.

L. Oertling, Ltd., exhibited a new prismatic reflecting micro balance, capacity 10 gm., sensitivity 0.001 mg. This balance is provided with a prismatic reflecting device, illuminating a magnified reading of the radial graticule attached to the end of the pointer—having 100 divisions each side of a central zero, thereby giving automatic readings in $1/1,000$ ths of a milligram up to 0.1 mg., plus or minus without the use of riders or fractional weights.

Liquefied propane, available in light steel cylinders for use in isolated school, university and works laboratories, was shown by Liquefied Gases, Ltd. With the aid of this hydrocarbon, Bunsen burners, furnaces, torches for glass blowing, soldering and brazing, etc., may be operated independently of town gas supplies. The temperature of a propane flame is $2,350^{\circ}\text{F}$., and both propane gas and its products of combustion are non-toxic. The cost of heating with propane is

double the average price of coal gas, corresponding to electric power at 1.5 pence per kilowatt hour for an equal number of British thermal units.

Adam Hilger, Ltd., exhibited a fully automatic large quartz spectrograph, with a wave-length scale indicating the actual range of spectrum recorded on the photographic plate. The adjustment is continuous and whatever the wave-length range on the plate the whole of it is then photographed in focus. In one model of this instrument a mechanism enables the user to substitute, instantly, a glass train for that of quartz without opening the spectrograph.

A new quartz spectrograph giving faultless definition over the whole range from 2,000 to 5,800 Å. was also shown by Carl Zeiss (London), Ltd.

A new optical pyrometer of the disappearing filament type was exhibited by The Foster Instrument Co., Ltd., it being recognised that under the conditions prevailing in some industries, an optical pyrometer with a separate battery and connecting lead, or a separate indicator connected to the telescope by means of cable tends to inconvenience the user.

The "KM" meter shown by George Kent, Ltd., has been recently redesigned and modifications have recently been made which give a still greater reserve of power, increased accessibility, adaptability for any sort of service conditions, and other features which have arisen out of long experience with this meter.

Organic Substitutes for Glass

A Review of Desirable Properties

Possible substitutes for glass among organic materials belonging to the synthetic resin group were referred to in a joint paper by Professor G. T. Morgan, Mr. N. J. L. Megson and Mr. E. Leighton Holmes, read before the Society of Glass Technology in London on January 8.

The properties desirable in glass and, therefore, in its substitutes, are cheapness, transparency, absence of colour, high refractive index, hardness, durability under working conditions, resistance to mechanical shock or change of temperature, high dielectric strength, and low water absorption. Synthetic resins of vitreous character possess certain of these properties, but in general they are comparatively costly to produce. They are less durable than glass under ordinary atmospheric conditions and are adversely affected by heat, that is, they soften, volatilise, or char at temperatures below 300°C . They are generally much softer than glass and certain varieties have a high water absorption. On the other hand they have such advantages as flexibility and good machining properties; they are often less brittle than ordinary glass.

Two main types of resins are known commercially: condensation resins and polymerisation resins. Of the former type the most important group is that of the phenol-formaldehyde resins in which considerable advances have recently been made leading to materials resembling glass. These vitreous varieties are producible by casting. This procedure, which is adopted for fancy goods and artificial jewellery, furnishes transparent articles of pale colour. Darkening of tint, which is somewhat characteristic of aromatic resins, is avoided by operating the thermohardening process slowly at comparatively low temperatures. Urea-formaldehyde and thiourea-formaldehyde resins which also belong to the thermohardening condensation group bear a very close resemblance to clear colourless glass when prepared without fillers, but in practice they are generally impregnated with fillers and tinted with pigments to form moulding materials from which may be prepared non-fragile domestic ware, including tea services and tumblers. In these applications they are employed as substitutes for porcelain rather than for glass.

Polymerisation resins, which are made from unsaturated

organic compounds containing the group $\text{CH}_2:\text{C}<$, are thermoplastic for they remain fusible under heat treatment. They also retain their solubility in organic solvents, a property which distinguishes them from the thermohardening group. Polymerisation resins arise from compounds containing the vinyl group and may be either entirely aliphatic or partly aromatic. In the former class are included the resins from vinyl halides, ethers and esters, the closely related acryl esters and nitriles, and the methylene ketones. In the latter partly aromatic class are the resins from styrene vinylbenzene and its analogues. Many of these polymerisation resins can be produced in colourless vitreous forms. The polymericides of the aliphatic vinyl class have low softening or decomposition points and relatively high water absorption. They have the great advantage of excellent machining properties. This characteristic was illustrated by a display of artistically turned articles. The aromatic vinyl resins of the polystyrene class have remarkably good dielectric properties and their water absorption is negligible.

The preparation of methylene ketonic resins which has been developed at the Teddington Laboratory was briefly described, and a detailed comparison was made of the physical and chemical properties of glass with those of the vitreous synthetic resins. Possible improvements in the properties of the latter group were suggested, such as cross linking of chain molecules by divinyl derivatives, polymerisation of vinyl esters of poly-alcohols and conjoint polymerisation of different types of vinyl compounds.

Sulphur Production in Chile

SULPHUR production in Chile during 1934 showed a marked increase over that of the previous year. Part of this was justified by the increase in exports from 14,287 to 16,796 tons. The total production during the year was 20,683 tons, compared with 12,759 in 1933. At present one of the principal producers, the Cia. Azufrera del Pacifico is shut down for the purpose of installing new equipment.

Lubricating Oils from Coal Products

Some Indirect Methods of Synthesis

A CONSIDERABLE amount of work has been carried out upon the conversion of coal into liquid motor fuels, but comparatively little attention has been paid to the equally important question of the production of lubricants, according to a paper on "The Production of Lubricating Oils from Coal Products" read jointly by Mr. F. C. Hall, Mr. W. R. Wiggins and Professor A. W. Nash, at a meeting of the Institute of Fuel in London on December 12.

The annual consumption of lubricating oils in the United Kingdom, although in amount very much smaller than that of motor spirit, is about 115 million gal., of which approximately 30 per cent. represents motor lubricants. Motor lubricants are usually selected by means of standardised laboratory testing methods, and, in the absence of an actual engine test, a reasonable degree of evaluation may be obtained in this manner. Where the temperature conditions of operation vary widely, as in internal combustion engines, a minimum variation in viscosity with temperature is desirable; a viscosity index is therefore adopted to evaluate the temperature coefficient of viscosity, this factor varying from below zero for oils whose viscosity changes rapidly with temperature to a value of 100 and over for oils with a low viscosity-temperature coefficient. At low temperatures the ability of a lubricating oil to retain its fluidity is of obvious importance; this property may be evaluated by the pour point test when the minimum temperature at which the oil will just pour is determined. Some indication of the ability of an oil to withstand thermal decomposition is afforded by the carbon residue test which determines the percentage carbon residue remaining after destructive distillation under standardised conditions. Reasonable stability towards oxidation is also essential for any lubricant.

Five Methods of Synthesis

Although high-grade lubricating oils probably cannot be prepared directly by coal distillation, it is possible to utilise various coal products as raw materials for the synthesis of satisfactory lubricants. Such indirect methods of synthesis from coal products may be summarised as: (1) The non-catalytic polymerisation of hydrocarbons, (2) the catalytic polymerisation of olefines, (3) the dechlorination of chlorinated hydrocarbons, (4) the condensation of olefinic with aromatic hydrocarbons, and (5) the condensation of alkyl chlorides obtained by the chlorination of coal products with aromatic hydrocarbons.

For the production of hydrocarbon molecules of a size comparable with those found in petroleum lubricating oils, from starting materials of comparatively low molecular weight, some type of polymerisation or condensation reaction is necessary. By reason of their unsaturated and reactive nature, olefinic compounds lend themselves most readily to polymerisation reactions, and offer a suitable material for the production of polymers of widely varying molecular weight. In the case of the more stable saturated hydrocarbons, polymerisation may be achieved through the preliminary or intermediate formation of an unsaturated hydrocarbon and its subsequent polymerisation to a more complex molecular condition. Such a reaction may be attained through dehydrogenation, or chlorination of the initial material followed by dechlorination and polymerisation of the resultant unsaturated molecules. The thermal polymerisation of hydrocarbons for the production of lubricating oils, however, has not attracted any great degree of attention, although their conversion to low boiling liquids suitable for motor fuels has been widely investigated.

From the exothermic nature of polymerisation reactions it follows that low temperatures will favour polymerisation, and

high temperatures depolymerisation, although at moderate temperatures the velocity of reaction is low. Consequently the use of catalytic material is necessary to accelerate low temperature polymerisation; catalysis also secures some degree of selectivity for this reaction. Thermal non-catalytic polymerisation of olefines is unsuited to the production of lubricating oils, but the silent electric discharge, as in the Siemens ozoniser, causes polymerisation of olefinic and saturated hydrocarbons to compounds of widely varying molecular complexity without the use of catalysts.

Effect of Catalytic Action

The polymerisation of unsaturated hydrocarbons is accelerated to a marked degree by catalytic action. A wide range of catalytic materials is available for this purpose, including certain inorganic acids, notably phosphoric and sulphuric, a number of volatile metallic and non-metallic halides, and active bleaching earths. The majority of these catalysts appear to function by the intermediate formation of a comparatively unstable compound of the unsaturated hydrocarbon and the catalytic material, followed by its decomposition, and regeneration of the catalyst with production of polymerised bodies.

The polymerisation of liquid olefines with aluminium chloride is normally carried out at temperatures below 100° C., using less than 10 per cent. of catalyst. Increase in the proportion of aluminium chloride used reduces the time of polymerisation but results in greater loss of material in the form of sludge. The use of higher reaction temperatures likewise reduces the time of reaction, but decreases both the yield of viscous oil and the viscosity index of the product.

Synthetic lubricating oils from the polymerisation of olefines possess, in general, low pour points and carbon residues. By selection of suitable initial olefinic material it is possible to produce lubricants exhibiting high stability towards oxidation and sludge formation, and with viscosity indices comparable with, or exceeding, those of petroleum lubricating oils.

Thermal Decomposition

Thermal decomposition, with or without catalysts, of chlorinated hydrocarbon material results in the formation of either resins, tars, drying oils or lubricating oils, according to the initial substance and the reaction conditions. Dechlorination is essentially a decomposition reaction in which the chlorine is removed as hydrogen chloride, and is usually followed by cyclisation and polymerisation of the resulting unsaturated residue. The material upon which most investigations for the production of lubricating oils by dechlorination have been based is chlorinated paraffin. Suitable paraffin material for chlorination may be isolated from low temperature carbonisation tars or synthesised directly from water gas as indicated previously.

Chlorination of paraffin is carried out by passing chlorine into the paraffinic material maintained at a suitable temperature. Vigorous agitation and good liquid-gas contact are essential. Iodine acts as a catalyst for the chlorination reaction and the presence of metals such as iron, copper and aluminium assists dechlorination. Heat increases the velocity of chlorination, but since the reaction is exothermic it is necessary to control the temperature in order to avoid premature decomposition of unstable chloro-paraffins. The chlorinated material may be subjected to simple thermal decomposition at temperatures between 250° and 350° C., or decomposed in the presence of a catalyst (such as aluminium chloride or activated aluminium) at lower temperatures.

Olefines may be condensed with aromatic hydrocarbons using aluminium chloride, boron fluoride, ferric or zinc chloride catalysts, and under suitable conditions of temperature and pressure, viscous oils with lubricating properties are produced. In the preparation of viscous oils by this reaction cracked gasoline and kerosene have been used by numerous investigators as the olefinic raw material, and fractions from aromatic oils have been employed as the source of aromatic hydrocarbons. Condensation may be carried out in either the liquid or vapour phase in the presence of suitable catalysts.

The preparation of lubricating oils by the condensation of ethylene and naphthalene using aluminium chloride catalyst has been investigated in the Department of Oil Engineering and Refining at Birmingham University. The results to date indicate that for complete conversion of the naphthalene at least 20 per cent. aluminium chloride catalyst is necessary, and the temperature for complete conversion of the naphthalene must be at least 250° C. and at this temperature the greatest and most rapid condensation of ethylene is obtained. Although hexaethylbenzene is formed under certain conditions it does not appear when less than 30 per cent. aluminium chloride is used. The yields of fractions with viscosities comparable to those of lubricating oils are relatively large, but there is always a large amount (up to 30 per cent. of the product) obtained as a resinous residue boiling above 250° C./10 mm.

Points from the Discussion

The CHAIRMAN said it was to be wondered why people tried to get lubricating oil from coal. As long as oil was available naturally there would be an abundance of lubricating oil, and the new methods of solvent extraction were rendering more and more crude oils available as sources of good lubricating oils. Nevertheless, we should come to the time when it would be necessary to look to other things than petroleum and eventually we must fall back on coal, and from that point of view Professor Nash was taking the long non-political view in studying this question in time. Other people were also going into this matter and Dr. King would no doubt say something about the work of the Fuel Research Board.

Dr. A. E. DUNSTAN said that on the whole question of the chemistry of lubricating oils it must be agreed that we were in a state of entire ignorance. After 20 years' work on this subject he did not personally know of one definite specific hydrocarbon which had been isolated—apart from Professor Nash's materials—and actually existed in the so-called lubricating oils. Nothing was known on this subject and it would be a great step forward if it were possible to synthesise something of the nature of a lubricant. Lubricating oil in the ordinary course had to possess very many curious characteristics. It had to have the famous viscosity index, stability against oxidation and a vast number of other properties, but who could tell us what sort of chemical compound would fulfil all these peculiar characteristics. Personally, he had a kind of idea that a lubricating oil was not just a plain chemical entity. He remembered many years ago at University College, in the days of the late Sir William Ramsay, a number of commercial oils were tested in the ultra-microscope and every one of them showed colloidal characteristics. He believed that Ostwald, some 30 years ago, rather indicated that a lubricant was an iso-colloid, *i.e.*, a two-phase system, in which one phase was a highly complicated compound of molecules of high molecular weight dispersed to a greater or less extent in some hydrocarbon medium, and this rather explained why it was that a lubricating oil functioned.

It was a common error to imagine that a lubricating oil acted as a lubricant. The bearing surface was just as important as the lubricant, and if we accepted the idea of a colloidal system adsorbed in part on the bearing surface, then we had a very good working hypothesis. Dr. Thole and he (Dr. Dunstan) considered that aspect some years ago and came to a conclusion which, when one came to think

of it, was easy to come to. Taking an excellent lubricant such as castor oil or olive oil or the ordinary fats, how did they differ from the well-known excellent lubricants of the mineral oil series. The difference was merely the higher molecular weight, and it was to be hoped that Professor Nash and his school would go on trying to build these things up and obtain a molecular weight very much higher than they had at present, and see if by so doing it was possible to obtain first of all this colloidal structure—whatever it was—and, having got that, then this peculiar and curious adsorption on the bearing surfaces. It was necessary, however, to have the two phenomena side by side. The consideration of the correlation of molecular structure and molecular weight was one of the most important things to be dealt with.

Necessity for the Long View

Dr. KING (Fuel Research Station) remarked that the petroleum people were apt to say "Why look for oils from coal when petroleum oils are perfectly satisfactory?" but it was necessary to take a long political point of view and have regard to the fact that in times of stress it might be necessary to make lubricating oils from coal. Therefore, there was every reason why we should now try to find out. It was no use waiting for an emergency to arise, and then start experimental work. It was fairly obvious, although Professor Nash had not mentioned it, that this method of preparing lubricating oils was expensive, but personally he did not think the question of expense should be allowed to enter into this matter. We wanted to know how it was done and something about the chemistry of it, hoping in that way to supply some of the lack of knowledge of the chemistry of lubricating oils to which Dr. Dunstan had referred. It had been recognised for some considerable time that the liquid products obtained by the carbonisation of coal were of no value for the production of lubricating oils by any simple treatment such as distillation. The same seemed also to be the case as regards the products obtained by the hydrogenation of coal.

The indirect methods which the authors had described in detail of obtaining lubricating oils from coal products had been arousing considerable interest in many places, and at the Fuel Research Station a little work in that direction had been done during the last five or six years. The Universal Oil Products Co., in America, had just published an interesting symposium of nine papers ("Ind. Eng. Chem.," Aug.-Sept., 1935) on the cracking of gaseous hydrocarbons and the polymerisation of unsaturated hydrocarbons, stopping at present at the end product, motor spirit.

Work at the Fuel Research Station

With reference to the section of the paper dealing with the polymerisation of liquid unsaturated hydrocarbons with aluminium chloride, Dr. King said he felt it might be most important to separate the unsaturateds from the remainder of the liquid and examine these separately. When at the Fuel Research Station they carried out experiments on one mixture, *i.e.*, low temperature gas spirit, they obtained a product which gave rather a mixed result, both a polymerised product and a condensation product. It might, therefore, now be worth while to separate or concentrate these unsaturateds and consider disentangling the result entirely from the chemical point of view. By this he did not mean that a better oil would be produced, but it would be possible in that way to find out something more about the chemistry. In carrying out these tests much the best results were obtained from liquid unsaturateds of low boiling point, and, when the corresponding unsaturateds in the higher boiling fractions were examined equally, good results were not obtained. Professor Nash had now shown how he had improved the old work on the polymerisation of the ethylene by using aluminium in association with aluminium chloride catalysts. As to the oils themselves, he noticed that most of Professor Nash's oils were nice and clear, but the oils

obtained at the Fuel Research Station, although they were satisfactory in many ways, seemed to present a curious milky appearance on standing, although there was never a definite deposit.

Continuing, Dr. King remarked that he hardly knew what to say about the chemistry of these substances, but when Dr. Dunstan said that after his many years in the industry he knew nothing about it, he was reminded of what was said at the Fuel Research Station the other day, *viz.*, that it was high time somebody took a lubricating oil, divided it up and really found out something about it physically. The authors' definition of lubricating value was not sufficient. A knowledge of these certainly did eliminate unsatisfactory oils—coal oils failed mostly owing to lack of resistance to oxidation at a high temperature—but the true lubricating value of an oil could only be assessed under practical conditions at present and a real laboratory test for assessing lubricating value was long overdue.

Viscosity Index and Lubricating Value

Dr. HORTON (Fuel Research Board) said it was well known there was a rough parallelism between viscosity index and lubricating value in the case of mineral oils, but it did not necessarily follow that there was the same parallelism when dealing with synthetic oils such as were prepared by the polymerisation of ethylene and other unsaturated hydrocarbons. The possibility of utilising the unsaturated hydrocarbons of low temperature gas as a sort of lubricating oil had been examined at the Fuel Research Station, and certain experiments had been conducted at 200 atmospheres pressure. Carbonising Dalton Main coal in horizontal mild steel retorts at temperatures from 700° C. downwards, gave ethylene yields in cu. ft. per ton varying from 5.5 at 40° to 204 cu. ft. per ton at 700°, which converted into lb. of ethylene per ton varied from 0.4 to 15.9, and if it were assumed that the whole of that ethylene could be utilised and converted into oil it only meant 1½ gal. or 15-16 lb. of oil per ton of coal carbonised. The experiments at the Fuel Research Station yielded small quantities of oil, but in order that the ethylene should be more completely polymerised it would be necessary either to adopt pressures in excess of 200 atmospheres or else saturate the ethylene in some way. As was stated in the paper, the polymerisation products produced by any particular catalyst were not necessarily saturated in character; in fact, they might still be olefinic and capable of further polymerisation, for one of the products obtained at the Fuel Research Station, a light spirit boiling up to 650° C., contained as much as 9.3 per cent. aromatics. This material had been polymerised with other catalysts and further quantities of oils had been produced with a very much higher viscosity index.

Chlorine Content

Attempts had also been made at the Fuel Research Station to obtain lubricating oils by condensing ethylene with certain fractions obtained by the hydrogenation of coal. The oils produced were in all cases sufficiently unstable towards oxidation to prohibit their use as lubricants. They had also made attempts to produce lubricants by chlorinating the hydrogenation products of coal and later subjecting them to condensation reactions involving halogen removal, but in all cases they obtained oils containing very considerable chlorine. They never succeeded in removing the chlorine completely, and that again would condemn their use as lubricants in the internal combustion engine.

Dr. THOLE, referring to the stability of these oils, said the particular conditions were not familiar to the ordinary petroleum chemist and therefore it was rather hard to assess the stabilities of the oils. What would they be under the more drastic conditions of the Air Ministry test? An important point was the presence of chlorine. It was pointed out in the paper that synthetic oils made with aluminium chloride and aluminium products were practically free from

chlorine, the chlorine content being below 0.1 per cent. That, however, was a high figure and he would like to know whether some of the more recent synthetic oils of the Paraffin type also contained chlorine to any measurable extent. If so, he imagined they would be very corrosive in use.

Mr. GOODAY drew attention to the statement in the early part of the paper to the effect that the consumption of lubricating oils in this country amounted to 115,000,000 gal. per annum, and said it would be interesting to know how that figure was obtained because the Board of Trade returns showed the quantity to be 100,000,000 gal. in 1934. That figure was published in June, 1935. Referring to samples of oil exhibited by the authors, Mr. Gooday said they were extremely interesting, but it would be even more interesting if Professor Nash would give a hint as to their application. In other words, were oils produced from one class of raw material more suitable, for example, for turbine lubrication or for the lubrication of internal combustion engines. Reference had been made by the Chairman to work which engineers should do, part from fundamental research, but he believed engines were doing something with regard to the use of lubricants in the sense that they were using lubricants more intelligently and were endeavouring to recondition them not by one means but by many means.

Professor Nash's Reply

Professor NASH, replying to the discussion, said the point in regard to the Air Ministry test was that he had been asked some time ago to prepare this paper, but it had had to be rather rushed in order to provide something of interest. Instead of air, which was used in the Air Ministry test at 200°, he used oxygen at 165°, but he regarded that as a much more punishing test than the Air Ministry test as usually carried out. The whole idea of the research that was carried out in his laboratory at Birmingham was to do the fundamental scientific work, but when it came to research on a semi-technical scale then he regarded that as the duty of research laboratories such as those at Amsterdam or Delft or Sunbury, which belonged to the oil companies. As to it being high time that a lubricating oil was split up, he entirely disagreed with this view for he believed that the only way in which it would be possible to discover the chemical constitution of a lubricating oil or of petrol was to synthesise it, starting with materials which were pure. It would never be done in a thousand years if any attempt was made to split up a commercial lubricating oil. It had, however, been very interesting to hear from Dr. Horton what was being done by the Fuel Research Board, and it all emphasised the belief that the taxpayer was getting a good return for the money spent on the Fuel Research Board during the last few years. In reply to Dr. Thole, Professor Nash said the oils which had been produced at Birmingham were chlorine free.

Spanish Iron Oxide Industry

Optimism During 1935

THE Spanish iron oxide industry, which experienced a critical period in 1934, evinced a marked tone of optimism during 1935. The reasons ascribed to conditions within the industry are increased export demand based upon possible ameliorating economic conditions in consuming countries, also a reduction of price of the oxides. It is estimated that the total production of iron oxides in 1935 will reach approximately 16,000 metric tons. A number of Spanish iron oxide producers have made strong representation to the Government for the concession of State financial aid for establishing a national paint manufacturing industry sufficient to supply national requirements. Exports of iron oxides for the first 8 months of 1934 and 1935 were, respectively, 293 and 228 metric tons. Germany and Austria have been important purchasers and demands for naval stores have recently come from the Netherlands.

The Handling and Use of Liquid Chlorine

An Important Paper Read Before the Chemical Engineering Group

A VERY practical paper was read by Mr. F. Holt, M.Sc., before the Chemical Engineering Group in London on January 10. The paper in question concerned the practice which should be followed and the precautions which should be taken in handling and using liquid chlorine. It also gave summaries of regulations governing the design, manufacture and transport of liquid chlorine containers (of both the solid drawn and welded types) in this and some other countries.

The essentials for safety are a container of adequate strength and prohibition of over-filling. In dealing with containers, Mr. Holt said that provision for records which gave a complete history of each container from the analysis of the original cast of steel to the date of scrapping was essential. All details of manufacture, hydraulic tests, all fillings and each trip to each customer must be recorded. The container must be emptied and internally inspected after each trip, any foreign matter being removed and examined. In the handling of large quantities in bulk and in a multitude of containers the most important item was dryness of the container and of the pipe-line system. For this reason, above all, the handling of the containers and the use of the contents by the customer necessitated co-operation between manufacturer and user.

Corrosion of Pipes

Liquid and gaseous chlorine when dry did not corrode steel at ordinary temperatures, but access of moisture to pipe-lines and valves resulted in very rapid corrosion. Containers should be stored in a cool, dry place in a fire-proof building. If a container were allowed to remain coupled to an absorption plant after all the liquid chlorine had evaporated, the residual chlorine in the pipe-line and container would dissolve, causing the liquid in the absorption vessel to be drawn back into the container. This might have serious results, as the decomposition of some of the liquids might, under certain conditions, cause a burst. Mr. Holt also discussed the two methods of connecting a cylinder of chlorine to a pipe-line, *i.e.*, by a union or a stirrup connection, of which the latter was the most convenient, and he gave details of valves and their operation.

In using drums the chief point was to arrange the two valves one above the other, the top valve controlling the flow of gaseous chlorine and the bottom valve regulating the flow of liquid chlorine. Where more than 20 lb. per hour was required from one drum it was advisable to withdraw the chlorine in the liquid state and vaporise it in an external coil, heated by warm water. Wherever possible, a pressure gauge should be connected to the valve not in use and the withdrawal of chlorine should be stopped when the pressure fell to 15 lb. gauge, to prevent a reversal of flow in the discharge pipe, since, especially with drums, the concave ends rendered adequate cleaning a difficult operation. The only satisfactory check on the amount withdrawn was to weigh the container. When withdrawing chlorine from a tank wagon it was also desirable to disconnect when the pressure fell to 15 lb. per sq. in. gauge, to prevent liquid being drawn back into the tank wagon.

The most important task in controlling storage tanks was to ensure adequate maintenance. Valves needed repacking frequently, the tank and pipe-lines must be kept painted and protected from high temperatures. Compressed air must be dry and free from oil. Above all, a periodical internal inspection and hydraulic test must be carried out. The hydraulic test should be maintained for at least an hour, and during this time a careful examination of the outside surface of the tank, especially the welds, must be effected

to discover any beads of water. These beads might be so small that no detectable diminution of pressure might occur on the gauge.

Pipe-lines for chlorine should be of solid drawn mild steel tubing of heavy gauge, and the joints either of the companion flanged type, usually adopted for refrigeration work, or British Standard flanges, using a full face joint ring. All material should be dried scrupulously before use. In the event of a blockage in a pipe-line, the best procedure was to release the chlorine from both ends of the pipe, steam out the pipe and dry by passing dry air. At the same time, the cause of the blockage should be ascertained. In view of the probability of excessively cold chlorine, owing to evaporation, and the great coefficient of expansion of liquid chlorine, no section of pipe-line should ever be left completely full between two closed valves, since a burst was probable.

Discussing the uses of liquid chlorine, Mr. Holt said the chlorination of water supplies was probably the greatest and was certainly the cheapest contribution by science to the safeguarding of the health of the people of the world. Almost every large town or city of the world used one or other variation of chlorination. A subsidiary advantage of chlorination was the prevention of the growth of organisms in the pipe-lines of towns. This applied more particularly to the chloramine process, in which residual available chlorine was somewhat more stable than in the simple chlorination process.

With regard to safety precautions, the most important item for customers was to ensure that all containers owned by them were tested periodically in the regulation manner. Next in importance was the dryness of equipment; the necessity for attending immediately to any leak in containers, apparatus or joints could not be over-emphasised. The smallest leak would grow worse at an amazing rate if in the presence of moist air. Cases had occurred, not in Great Britain, where cylinders with microscopic leaks had been thrown into rivers; usually corrosion had proceeded at such a rate that the whole contents of the cylinders had been discharged within a few hours. In the event of a serious leak, which was extremely rare with transport containers, it was recommended that the supplier be notified.

Precautions Against Gassing

If a leak of chlorine gas occurred, persons in the vicinity should move to the windward side immediately, and a respirator should be procured before returning to investigate. For low concentrations of chlorine, box type respirators were suitable, but for very high concentrations self-contained oxygen breathers were necessary. It was seldom that the latter were necessary, but they should be available wherever liquid chlorine was kept in bulk. Short-distance breathers, *i.e.*, masks with 30-ft. air pipes leading into fresh air, were not recommended except for use in tanks owing to the difficulty of ensuring that the free end of the air pipe was in uncontaminated air. Of equal importance with the provision of masks was the adequate training of employees in their use. With self-contained breathers, this should comprise not only an initial training but also a periodical wearing of the apparatus, say, monthly. In a case of gassing, the patient should be removed into an uncontaminated atmosphere as quickly as possible, and should be kept warm and at rest. Suitable drinks were provided by (1) one or two teaspoonfuls of glycerine in a tumblerful of soda water, or (2) hot tea or coffee, to which a lump of butter may be added. In every case of gassing by chlorine the patient should be seen by a doctor, as serious symptoms might develop at a later stage.

Recent Advances in Catalysis

A Series of Lectures by Dr. E. B. Maxted

THREE lectures on recent advances in catalysis were given by Dr. E. B. Maxted in the Department of Chemistry, Bristol University, on October 14 and 28 and November 11. The first of these lectures dealt with certain aspects of the principles which underlie catalytic action generally. In the first place, said Dr. Maxted, every catalyst possesses some measure of associating power for one or more of the constituents of the system catalysed; and it is at once evident that this association is in some way responsible for the activation process by means of which the catalytic reaction proceeds. Moreover, what seems to be required is not a stable compound but rather a state in which, by dissociation or otherwise, there is an active kinetic interchange of linkages between the catalyst proper and the component towards which the affinity is exerted. In some cases, association with more than one of the reacting species is apparently necessary. Thus, in the synthesis of ammonia, ordinary hydrogen-activating catalysts are inactive; but iron, which also adsorbs nitrogen readily if the metal is in a suitable form, catalyses the reaction at a rate which is of the same order as the velocity of adsorption of nitrogen. Accordingly, by considering the ordinary chemical or associating properties of available contact bodies, it is often possible to predict the suitability of a catalyst without actual trial.

Initiation of Reaction

Retention will, in itself, increase the probability of the acquirement of the energy increment necessary for the initiation of reaction. This may take place by superposition effects of vibrations or pulses of displacement of arbitrary phase, as was suggested by J. J. Thompson; or the formation of an adsorption complex, associated with a relatively large number of internal degrees of freedom, will, as has been pointed out by Storch, facilitate the provision of the critical energy by contributions from these. Further, the lesser value of the activation energy of a catalysed reaction, compared with the value for the same reaction in a non-catalysed form, suggests a catalysed course in stages such that the energy barriers between the initial state and the association complex, and between the association complex and the final state respectively, are less than the critical increment required for the non-catalysed change. This was illustrated for the passage of acetic acid to acetone.

The contribution of the heat of association towards the activation energy, as developed recently by zur Strassen, apparently affords a reasonable explanation, for instance, of the reversal in the sign of the temperature coefficient observed in certain hydrogenation reactions, in which this reversal, when followed kinetically, is seen to be accompanied by the appearance, as an effective factor in the determination of the reaction rate, of a new exponential term. The accelerating influence of dissociation effects brought about by adsorption by a catalyst was also discussed in conjunction with London's classification of reaction types; this subject, said the lecturer, has been developed by Polanyi, particularly for hydrogenation catalysis.

Catalytically Active Surfaces

Dr. Maxted's second lecture dealt specially with certain properties of catalytically active surfaces. Taylor's conception of active points, he said, has been re-considered by a number of workers. Thus, O. Schmidt has called attention to Tammann and Boehme's observation of the relatively short life of small rods or films of metals even at moderate temperatures, an effect which should be even more intense with extra-lattice projections of atomic dimensions; and Schwab, Pietsch and others, in a number of papers on adlineation effects, have developed the consequences of the experimentally

observed special activity of one-dimensional phase discontinuities such as crystal edges or of discontinuities associated with Smekal cracks or with the presence of a further solid phase. Particularly in the case of crystal edges, the preferentially adsorbing or catalysing elements of the crystal lattice should all be energetically equivalent, save for the exceedingly small number of cases where the concurrence of crystal edges results in adsorbing elements at points.

The evidence for the energetic homogeneity of the catalysing range of adsorbing elements has in the past few years been re-examined in collaboration with G. J. Lewis, V. Stone and C. H. Moon. In the course of this work it has been shown that the step-wise inhibition of, for instance, the capability of hydrogenation catalysts to catalyse reactions of varying difficulty, observed by Vavon and Husson, disappears if great care is taken to employ a reacting system completely free from original poison. Further, no change is observed in the activation energy of reactions which, by the progressive poisoning of the catalyst, are caused to take place on a gradually decreasing residual fraction of the original catalysing range of surface elements; nor is any change in this energy term observed if the surface is progressively stabilised by heat treatment. Additional indications of uniformity may be deduced from the general form of the poisoning graph.

The non-variation of the differential heat of adsorption, which has been established for certain cases—principally for the adsorption of hydrogen or oxygen on metals—by Ward, Beebe and by the lecturer in collaboration with Hassid, apparently points to homogeneity throughout the whole adsorbing range; but the subject is complicated by the composite nature of the adsorption process involved. However, evidence for effective uniformity may also be obtained from the work of Steacie and Elkin, who have shown that there is no discontinuity in activity at the melting point of zinc, when this metal is used as a catalyst in the decomposition of methyl alcohol, from which it is concluded that the whole surface is uniformly active; for, if active centres were involved in the catalytic reaction on solid zinc, it would be expected that there would be a sudden, and probably large, drop in activity at the melting point.

Nature of the Adsorption Process

The nature of the adsorption process itself was next discussed by Dr. Maxted, with special reference to the development of H. S. Taylor's theory of activated adsorption. This theory affords a reasonable explanation of the variation of the gross adsorption with temperature and of certain adsorption anomalies, such as the observation of Garner and Kingman of the re-adsorption, without the necessity for a temperature change, of hydrogen desorbed by a catalyst. The subject has, however, become complicated by the necessity for the assumption of more than one high-temperature adsorption component in addition to van der Waal adsorption; and, with oxide catalysts, there is often the possibility of reduction: indeed, as several workers have pointed out, pure adsorption, in the case of hydrogen on oxides, can often not be assumed unless the gas is removable as such and not in the form of water. The assignment of relative catalytic importance to the various adsorption components was also dealt with.

In conclusion, Rideal's recent conception of activated migration, involving the passage of energy barriers and the control of the rate of the catalysed reaction by this speed of migration, apparently affords, even for a homogeneous surface, an explanation of why the obstructive occupation of a relatively few points by a poison should, by barring the way to migration, cause a greater degree of obstruction to catalysis than it does to adsorption.

Hydrogen Production by the Badische Process—VIII.

Removal of Carbon Dioxide and Sulphur

In continuation of notes on the Economics of the Synthetic Manufacture of Ammonia, published in "The Chemical Age," October 5 to November 16 inclusive, the present series deal particularly with the design of the plant for the production of hydrogen by the Badische Process.

THERE would evidently be an advantage in adding a diluent gas and it is suggested the remainder of the nitrogen should be added before the catalysis.

The resulting gas contains 9,648,650 cu. ft. of hydrogen, and for this quantity of hydrogen about 3,216,210 cu. ft. of nitrogen would have to be added. There are already 2,102,000 cu. ft. present, so that 1,114,110 cu. ft. can still be added. It would be advisable to leave about 10 per cent., so that the final composition in the gasometer could be adjusted more exactly from the nitrogen supply. Assume, therefore that 1,000,000 cu. ft. of nitrogen are added.

The total resulting gas* would have the following composition:—

H ₂	9,648,650	..	..	..	72.5 %
CO ₂	528,350	..	..	..	4.00%
N ₂	3,102,100	..	..	..	23.3 %
A	21,500	..	..	..	.15%
<hr/>					
	13,300,600				

The initial gas would have the following composition:—

H ₂	10,030,000	..	..	..	71.3 %
CO	381,350	..	..	..	2.7 %
N ₂	3,102,100	..	..	..	22.1 %
A	21,500	..	..	..	.15%
CO ₂	147,000	..	..	..	1.0 %
O ₂	381,350	..	..	..	2.7 %
<hr/>					
	14,063,300				

Design of Converter.

It would be inadvisable to take the data at present available in order to design the converters in which to carry out the fractional combustion, until experiments are further on. These will decide the velocities, etc., at which the gas should be passed over the catalyst. The general lines on which such design should be based can, however, be indicated and the size and number of converters can be estimated.

Gas Mains and Supply.

The gas (7,750 cu. ft. per minute) will be boosted from the gasometer through a main of diameter about

$$\sqrt{\frac{7,750}{60 \times 60 \times 0.786}} = \sqrt{2.74} = 20 \text{ inches maximum (say).}$$

and delivered at a pressure of about 2 lb. to the branch pipes of the interchangers and from there into the converters. The air will be blown in after the gas has been brought up to temperature (so as to avoid reaction in the interchanger

* The density of the gas would be:—

H ₂	71.3	×	2/100	=	1.426
CO	2.7	×	28/100	=	.755
N ₂	22.1	×	28/100	=	6.21
CO ₂	1.0	×	44/100	=	.44
O ₂	2.7	×	32/100	=	.863

9.69

385
= 0.0251 lb. per cu. ft.

Specific heat of the gas would be:—

H ₂	1.426	×	3.4	=	4.85
CO	.755	×	0.244	=	.18
N ₂	6.21	×	0.240	=	1.49
CO ₂	.44	×	0.236	=	.14
O	.863	×	0.244	=	.21

6.87

9.69
= 0.71

pipes). The steam will be added before entry into the interchangers. Control would be arranged for each converter. The nitrogen would also be added at the same point as the steam, the supply being derived from a main carrying nitrogen, boosted from the nitrogen supply gasometer.

Number of Converters.

It will be assumed from the result of previous experiments that about 1 cu. ft. of catalyst will deal with at least 500 cu. ft. H₂ at (normal pressure and 20° C.). So that on such basis the quantity of catalyst required would be

$$\text{For } \frac{9,648,650}{24} = 400,000 \text{ cu. ft. hydrogen per hour}$$

$$= \frac{400,000}{500} = 800 \text{ cu. ft.}$$

Assume the catalyst chamber to have a capacity similar to a Grillo converter, viz., 10 ft. × 6 ft. 6 in., and that the velocity of flow past the catalyst is made 30 ft. per second. The size of catalyst grains will be about $\frac{5}{8}$ in. diameter and the net area $0.0775 \times$ the gross area.

$$\begin{aligned} \text{Gross area} &= 33.2 \text{ sq. ft.} \\ \text{Nett area} &= 2.58 \text{ sq. ft.} \end{aligned}$$

The volume of gas flowing through all the converters at any average temperature 250° C. will be

$$\frac{523}{293} \times \frac{14.7 (14,063,300)}{10.7 \times 1,440} + 12,700 \text{ cu. ft.} = 15,350 + 12,700$$

$$= 28,050 \text{ cu. ft. per min.}$$

$$= 408 \text{ cu. ft. per sec.}$$

Therefore the number of converters required to pass the glass would be

$$n = \frac{408}{2.58 \times 30} = 0.06$$

The depth of catalyst necessary would be

$$\frac{800}{33.2} = 24.1 \text{ ft.}$$

Assuming there are four trays per converter, the depth of catalyst on each tray would be

$$\frac{24.1 \times 12}{4 \times 6} = 12 \text{ inches.}$$

Now from the thermal point of view it is important that the catalyst should not be present in too great a bulk, therefore it would seem advisable to increase the number of converters.

The depth of catalyst would be graduated on each tray, so that the lower layers are shallower than the upper, and the proportion of work which is done by each layer is as nearly equal as possible.

Let us assume the number of converters of 6 ft. 6 in. diameter to be 10. Then the velocity of flow would be

$$\frac{408}{2.58 \times 10} = 18 \text{ ft. per sec.}$$

It will be important to determine the depths of catalyst required to convert various percentages of the CO to CO₂ at this particular rate of flow.

Temperature Control in Converter.

It will be assumed that each layer will be made of such depth (i.e., surface) that 25 per cent. of the reaction goes

on in each layer. The volume of gas entering each converter would be 775 cu. ft. at 20° C. and normal pressure = 682 cu. ft. at 2 lb. pressure.

The quantity of steam would be 36.4 lb. per minute.

The volume of nitrogen would be 69.5 cu. ft. at normal pressure = 61 cu. ft. at 2 lb. plus pressure.

The volume of air added would be 132 cu. ft. at normal pressure = 116 cu. ft. at 2 lb. plus pressure.

The reaction will afford 4,340 C.H.U. per minute per converter, or 1,085 C.H.U. per tray.

The converter would lose less than 1,000 C.H.U. per minute by radiation, say, 200 C.H.U. per tray.

The heat available for raising the temperature of the gases would be 885 C.H.U. per tray.

The density of the gas (without the steam) is 0.0251 lb. per cubic foot at 20° C., or

$$\frac{0.0251 \times 293}{543} = 0.0135 \text{ lb. per cubic foot at } 270^\circ \text{ C.}$$

The mass of the gas will be

$$\frac{1,406,330}{1,440} = 975 \text{ cu. ft.} \times 0.0251 = 24.5 \text{ lb.}$$

The mass of the steam will be 36.4 lb.

The number of C.H.U. taken up per degree rise in temperature by the gas would be $(24.5 \times 0.71) = 17.4$, and by the steam $(36.4 \times 0.47) = 17.1$. So that for each degree rise in temperature 34.5 C.H.U. could be taken up, therefore, 885 C.H.U. would lead to a rise of temperature of $885/34.5$ or 25.7° C.

The gas should therefore enter the lower layer at about 245° C. Between each layer the gas would be taken out through an interchanger or cooler and reduced 25° C. in temperature. The gas leaving the converter would pass into the main interchanger, through which the incoming gas would also pass in the reverse direction. It will be assumed that the gas leaving the catalyst enters the interchanger at 270° , and the unconverted gas entering is raised in the interchanger to 240° C. The heat available from the gas leaving the last layer of catalyst* in cooling to 100° C. is

$$(24.5 \times 170 \times 0.71) + (37.6 \times 170 \times 0.47) = 2,970 / 3,000 = 5,970 \text{ C.H.U. per min.}$$

The heat required to raise to 245° C.

775 cu. ft. of gas + 36.4 lb. of steam + 69.5 cu. ft. of N_2 would be

$$1,425 \times 775 \times 0.0124 \times 225^\circ \text{ C.} + 36.4 \times 0.47 \times 143 \\ + \frac{69.5}{385} \times 28 \times 0.24 \times 225^\circ \text{ C.} = 3,080 + 2,440 + 273 = 5,793 \text{ C.H.U. per minute.}$$

Therefore efficiency of interchange

$$\frac{5,793}{5,970} = 98\% \text{ (radiation not allowed for).}$$

The loss of heat due to inefficiency of interchange will be made up from elsewhere.

Interchanger for Incoming Air.

The gas heated to 245° C. passes through the first layer after mixing with air previously heated by the gas passing from the first layer. Heat given out in interchanger in cooling from 270° to 245° C. has been shown to be 885 C.H.U.

* Specific heat of gas leaving catalyst:

72.5— H_2	..	..	1.45×3.4	= 4.93
4.0—CO	..	..	1.7×0.236	= 0.41
23.3—H	..	..	6.54×0.24	= 1.57
			6.69	6.91
				9.69

$$\text{Density at } 20^\circ \text{ C.} = \frac{9.67}{3.85} = 0.0251 \text{ lb. per cu. ft.} = 0.715$$

The heat required to raise 132 cu. ft. air (at 20° C. and normal pressure) from 20° to 245° C. is

$$225 \times 132 \times 0.0807 \times \frac{273}{293} \times 0.242 = 538 \text{ C.H.U.}$$

An interchanger between this gas and the entering air can therefore be arranged, working at $\frac{538}{885} = 60.6$ per cent.

efficiency. The advantage of separately heating the air is that no action takes place in the interchanger coils and the air and gas mix just before meeting the first layer of catalyst, distribution of the gas being arranged for by baffle plates or other means.

Control of Main Interchanger.

The heat from the second and third layers, amounting to $2 \times 885 = 1,770$ C.H.U. per minute, could be arranged to be taken through the main interchanger, thereby providing $5,970 + 1,770 = 7,740$ C.H.U. available heat, or allowing

$$\text{a total efficiency of interchange of about } \frac{5,793}{7,740} = 75 \text{ per cent.}$$

a cooler would be placed so that the gas could be bypassed from the second layer through this if necessary, thus admitting of perfect control of the catalyst tempera-

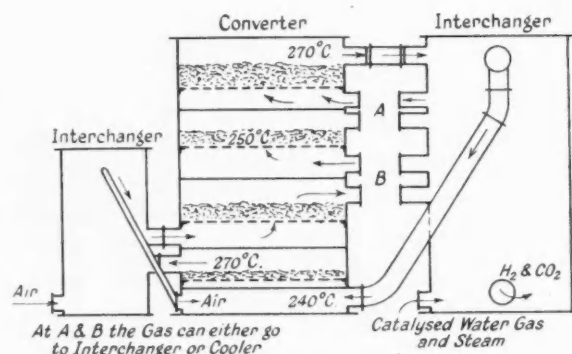


Diagram of Autothermic Converter and Interchangers.

tures. It would seem a catalyst chamber designed on the lines indicated would provide the necessary means of regulating the action and be perfectly autothermic. Whether the interchangers would be made part of or placed outside the converters is a matter of choice in design. The detail of the interchanger design is not worth considering until the surface velocity relations for the catalyst are definitely determined. This arrangement is shown diagrammatically in the accompanying illustration.

Magnesium Carbonate in Japan

MAGNESIUM carbonate prepared by a process developed at the Physical and Chemical Research Institute is to be produced at Kashiwasaki, Niigata Prefecture. The plant will start with a capacity of 10 metric tons daily, to be increased to 15 tons daily. It is financed by a new firm capitalised at 3,000,000 yen, owned by the Institute and the supplier of magnesite. Magnesite from Korea and Manchuria will be calcined to yield carbon dioxide and magnesium oxide. The magnesium oxide is powdered and dissolved in water to yield magnesium hydroxide, which reacts with carbon dioxide to form magnesium bicarbonate. The bicarbonate is subjected to a continuous charge of steam, and forms crystallised carbonate. The product is dried and powdered for shipment. Chief outlets for magnesium carbonate in Japan are in the manufacture of rubber goods, dentrifices and pharmaceutical products.

Letters to the Editor

Control of the Manufacture of Poisons

SIR,—Some comment appears to be called for in connection with the issue of the revised Poisons Rules. Your readers will be aware that both representatives of the Universities and of the British Association of Chemists drew attention to the findings of the Poisons Board regarding chemical qualifications since they considered that they were founded upon misconceptions. No actual undertaking was given by the Home Office to receive the Association's representatives in deputation, but the B.A.C. was given to understand that its views would be considered.

To what extent this supposition has been realised in fact can be gained by an examination of Section 29 of the revised Rules. It does not differ substantially from the original rule since it precludes all qualified chemists who are not members of the Institute of Chemistry from supervising the manufacture of medicinal preparations containing poisons. This, however, is not the most glaring anomaly of the Section. The clause has been retained which entitles those who have been engaged for three years in the manufacture of these preparations to supervise their manufacture. The only requirement is that they must furnish the Registrar of the Pharmaceutical Society with a statutory declaration that they have been so engaged for a period of three years. There is nothing even to suggest that the three years' practice must have been in a supervisory capacity. This means, in effect, that an ordinary workman might claim that he was qualified under these rules.

It might appear extraordinary to those who do not understand the workings of the official mind that legislation dealing with the manufacture of poisons should be introduced which precludes 60 per cent. of the chemical profession from practising this particular branch of their work while it allows others with no technical qualifications at all to undertake it. One of the arguments used in the Poisons Board report to justify the exclusion of all chemists not members of the Institute of Chemistry was that the Institute alone could exercise disciplinary action in the matter of professional malpractice. The report rightly stresses this as being important. It is a statement, however, which is untrue since the British Association of Chemists and at least some universities possess the same powers and the Board must, or ought to, have been aware of this at the time. Even, however, if this were not the case, the Poisons Rules entirely dispose of this alleged intention ethically to differentiate. It is nowhere suggested that those qualifying under the rule of three years' practice are to be subjected to disciplinary control of any kind. They are not required to be members of any society or institution which can ethically control them, and it is quite clear that the Pharmaceutical Society does not contemplate controlling them and could not do so if it did. The Pharmaceutical Society under the Rules merely receives and verifies the declarations made.

The position is therefore that restrictions have been made on the one hand which are intended to safeguard the public in such a way that these medicinal preparations shall be manufactured only by those with certain technical and ethical qualifications, while on the other a category is included in which there is no safeguard regarding either technical or ethical qualifications. It is therefore with some surprise that the Association has noted that its representations were ignored on the ambiguous ground that it did not confer any qualifications upon its members. Upon what evidence this statement is founded, and exactly what it means, might have been more evident, and differently expressed, had the Home Secretary agreed to meet the Association's representatives. At no period in the protracted discussion which led up to the issue of the Report and Rules were the Association's views specifically sought. Nor was any evidence taken from it at any time. It is quite evident that these Rules require

drastic modifications in this respect if in no other. The British Association of Chemists is taking further steps to re-open the question before the Rules are finally ratified in May.—Yours faithfully,

HENRY T. F. RHODES,

Editor, "The Chemical Practitioner."

British Association of Chemists,

"Empire House,"

175 Piccadilly, W.1.

Glacial Acetic Acid Production

SIR,—In his lecture to the Leeds Section of the Institute of Chemistry on November 25 on "The Technical Utilisation of Acetylene and Acetaldehyde," reported in THE CHEMICAL AGE of January 4, Dr. F. A. Mason is inadvertently in error in his statement of the capacity of the Shawinigan Chemicals, Ltd., glacial acetic acid plant. This is stated as 17,500 tons of glacial acetic acid per annum. The total installed capacity for this acid at Shawinigan is about 48,000 tons per annum and present production is actually in the neighbourhood of 36,000 tons.—Yours faithfully,

F. W. SKIRROW,

Technical Director.

Shawinigan, Ltd.,

Marlow House, E.C.3.

Institution of the Rubber Industry

London Section: Rubber Derivatives

IN view of the advent of cheap rubber and of the desirability of finding new openings for the raw material, chemists during the past few years have been considering whether raw rubber could not be utilised as the basis material for the manufacture of products or compounds other than those obtained by the interaction of rubber with sulphur, said Dr. P. Schidrowitz, F.C.S., F.I.R.I., in a paper on "Rubber Derivatives," read before the London Section of the Institution of the Rubber Industry on January 13. Much work in this connection has been carried out, and as a result several interesting rubber conversion products and rubber derivatives have been brought to the commercial stage and placed on the market.

The more important derivatives may be classified as (1) isomers of rubber or cyclo-rubbers, mainly of a thermoplastic character, (2) chlorinated rubber, (3) rubber hydrochlorides, and (4) rubber oxidation products. Among the products referred to by Dr. Schidrowitz are the thermoprenes (Vulcalock process, etc.); Plioform, which is a moulding resin developed by the Goodyear Rubber Co.; chlorinated rubber and expanded chlorinated rubber; Pliofilm, a material with a rubber-hydrochloride base, which is a strong stretchable wrapping and packing material, also developed by the Goodyear Rubber Co.; Rubbone, an oxidation product developed by Dr. Stevens and his colleagues; sticky latex, an adhesive obtained by the oxidation of latex; and an ethylhypochlorite derivative, which is promising from the point of view of finishing lacquers.

A number of the derivatives referred to were developed as the result of the work controlled by the Technical Research and Development of New Uses Committee, of the Rubber Growers' Association.

IMPORTED barium sulphate, formerly used in the Rumanian oil industry to increase the density of sludge in drilling operation, has been replaced by a product known as "ponderozita," prepared from pyrite calcine by the firm of "Maraseati" in its sulphuric acid plant at Valea Calugareasca, Prahova.

British Overseas Chemical Trade in December

Very Large Increase in Exports

According to the Board of Trade returns for the month ended December 31, 1935, exports of chemicals, drugs, dyes and colours were valued at £1,712,428, as compared with £1,513,881 for December 1934, an increase of £198,547. Imports were valued at £1,081,091, as compared with £881,492. Re-exports were valued at £62,602.

	Quantities.		Value.			Quantities.		Value.	
	December 31,	1935.	December 31,	1935.		December 31,	1935.	December 31,	1935.
	1934.		1934.			1934.		1934.	
Imports									
Acids—					Proprietary medicines				
Acetic cwt.	15,405	17,446	25,921	24,574	value	—	—	45,960	55,440
Boric (boracic)	6,686	4,800	6,545	4,794	All other sorts manufac-				
Citric "	1,978	1,514	6,172	5,950	tured or prepared				
Tartaric "	1,275	980	5,421	3,961	value	—	—	32,133	44,676
All other sorts .. value	—	—	16,833	10,989	Bark Cinchona (bark				
Borax cwt.	23,143	23,300	11,415	14,996	Peruvian, etc.) cwt.	294	668	1,047	3,164
Calcium carbide	101,087	113,309	57,639	60,951	All other sorts raw or				
Phosphorus "	722	727	2,351	1,970	simply prepared value	—	—	32,718	76,272
Potassium compounds—					Dyes and dyestuffs—				
Caustic and lyes cwt.	8,697	8,154	7,976	9,274	Finished dyestuffs (coal				
Chloride (muriate) ..	34,970	15,702	11,381	4,434	tar) cwt.	—	—	—	—
Kainite and other min-					Extracts for dyeing ..	3,936	3,826	10,477	8,452
eral salts .. cwt.	117,424	32,160	16,292	3,652	Chestnut extract ..	25,878	28,107	17,778	19,253
Nitrate (saltpetre) ..	29,758	40,886	10,943	17,257	Quebracho extract ..	45,455	21,284	24,380	17,482
Sulphate "	42,079	8,180	15,143	3,486	Other extracts for tan-				
All other compounds ..	11,119	10,768	19,037	17,367	ning cwt.	28,392	26,950	17,942	18,358
Sodium compounds—					All other dyes and dye-				
Carbonate, including					stuffs cwt.	607	1,387	2,260	20,154
crystals, ash and bi-					Painters' colours and ma-				
carbonate .. cwt.	5,491	484	1,885	331	terials—				
Chromate and bichro-					White lead (basic carbo-				
mate cwt.	2,329	7,497	3,305	9,502	nate) cwt.	6,012	6,615	6,698	8,545
Cyanide "	2,800	3,754	6,522	9,186	Lithopone "	15,489	17,813	10,228	11,468
Nitrate "	2,027	92,300	563	18,735	Ochres and earth colours				
All other compounds ..	22,699	33,709	17,165	22,874	cwt.	40,231	31,969	14,077	11,158
Other chemical manufac-					Bronze powders ..	1,526	1,665	10,341	11,908
tures value	—	—	215,116	302,061	Carbon blacks	38,552	45,836	59,955	70,698
Drugs, medicines, etc.—					Other pigments and ex-				
Quinine and quinine					tenders, dry .. cwt.	22,782	30,027	7,188	8,288
salts oz.	127,234	147,817	9,528	11,913	All other descriptions ..	8,457	10,823	21,334	21,952
Medicinal oils .. cwt.	2,630	1,000	8,747	3,273					
Ointments, etc. cwt.	6	6	348	377	Total value	—	—	881,492	1,081,091
Exports									
Acids—					All other sorts	56,874	62,458	75,995	76,495
Citric cwt.	2,536	1,642	8,744	7,108	Zinc oxide tons	1,164	1,077	21,487	19,980
All other sorts .. value	—	—	19,296	18,952	All other descriptions value	—	—	207,775	244,549
Aluminium compounds					Drugs, medicines and medi-				
tons	1,175	3,138	6,224	33,626	cal preparations—				
Ammonium compounds—					Quinine and quinine				
Sulphate tons	14,683	15,474	82,852	88,986	salts oz.	231,814	126,793	23,844	13,373
All other sorts ..	1,279	1,986	16,807	20,722	Proprietary medicines				
Bleaching powder cwt.	91,422	59,379	22,588	17,050	value	—	—	92,487	88,182
Coal tar products—					All other descriptions ..	—	—	140,021	139,926
Cresylic acid .. gal.	65,511	169,161	7,033	15,566	Dyes and dyestuffs—				
Tar oil, creosote oil, an-					Alizarine, alizarine red				
thracene oil, etc. gal.	103,153	1,262,965	4,639	34,906	and indigo (synthetic)				
All other sorts .. value	—	—	12,272	41,251	cwt.	455	1,921	4,165	14,046
Copper, sulphate of tons	1,383	1,856	17,925	27,052	Other finished dyestuffs				
Disinfectants, etc. cwt.	35,208	29,385	72,359	63,747	coal (tar) cwt.	6,911	7,597	83,883	108,823
Glycerine "	15,979	17,306	36,515	39,850	All other descriptions ..	26,135	20,800	29,239	27,948
Lead compounds	10,060	10,169	11,695	13,530	Painters' colours and ma-				
Magnesium compounds					terials—				
tons	356	456	8,914	9,900	Ochres and earth colours				
Potassium compounds					cwt.	12,669	13,510	13,480	14,040
Sulphate cwt.	4,250	2,293	9,381	9,652	Other pigments and ex-				
Salt (sodium chloride) tons	20,860	18,465	58,196	52,686	tenders, dry .. cwt.	14,198	18,193	24,981	26,246
Sodium compounds—					White lead "	5,637	5,807	10,124	10,134
Carbonate, including					Paints and painters' ena-				
crystals, ash and bi-					mels, prepared cwt.	36,884	36,117	90,544	95,056
carbonate .. cwt.	332,587	491,253	89,580	109,470	Varnish and lacquer gal.	84,157	65,558	30,595	24,421
Caustic "	174,864	239,446	101,698	115,479	All other descriptions				
Nitrate "	11,903	13,539	4,401	4,339	cwt.	33,255	41,543	69,121	76,408
Sulphate, including salt-					Total value	—	—	1,513,881	1,712,428
cake cwt.	51,011	114,728	5,021	9,019					
Re-Exports									
Chemical manufactures					Dyes and dyestuffs and				
and products .. value	—	—	14,145	35,341	extracts for dyeing and				
Drugs, medicines, etc.					tanning cwt.	196	638	559	1,196
Manufactured or pre-					Painters' colours and ma-				
pared value	—	—	13,133	11,900	terials cwt.	327	571	824	1,407
Raw or simply prepared					Total value	—	—	45,029	62,602
value	—	—	16,368	12,758					

Personal Notes

MR. G. B. HAY, chemical manufacturer, Burlington House, 1658 Maryhill Road, Glasgow, left estate valued at £6,865.

MR. H. O. SMITH, chairman of I.C.I. (Metals), Ltd., has been elected a director of Imperial Chemical Industries, Ltd.

MR. H. O'NEILL, research metallurgist, Derby, has been appointed chief metallurgist in the research department of the L.M.S. Railway.

PROFESSOR C. L. JACKSON, emeritus professor of chemistry in Harvard University, and well known for his work in organic chemistry, has died at the age of 88.

MR. P. D. H. HENDRIKS, managing director of N. V. Van den Bergh's Fabrieken, has been appointed a member of the board of Unilever, Ltd.

THE EARL OF BESSBOROUGH has been elected a director of the Rio Tinto Co., Ltd., in the place of MR. J. GORDON MACLEOD, who has resigned.

MR. G. R. BOLSOVER, chief metallurgist, and MR. S. A. JACKSON, works manager, have been appointed directors of Samuel Fox and Co., Ltd.

MR. F. H. ALCOCK, F.I.C., who was in practice as an analytical chemist in Birmingham for more than fifty years, died on January 13 at the age of 78.

MR. E. J. FOX, managing director of Stanton Ironworks Co., presented the awards at the annual dinner of the Stanton Ironworks division of the St. John Ambulance Brigade. Mr. Fox is president of the division.

SIR F. GOWLAND HOPKINS will deliver the foundation oration at the celebration of the one hundred and twelfth anniversary of the foundation of Birkbeck College on January 22.

MR. THOMAS PARKER, the "father of smokeless fuel," was honoured posthumously in London on January 14, when a gold medal was presented to his son by DR. H. A. DES VŒUX (president of the National Smoke Abatement Society).

MR. G. C. PELHAM, British Trade Commissioner and Commercial Secretary in Hong Kong, will be available at the Department of Overseas Trade from January 20 to February 8 for the purpose of interviewing manufacturers and merchants.

MR. WILLIAM MILLER, on the occasion of his retirement after having been in the service of the United Turkey Red Co., Ltd., at the Alexandria Works for 47 years, was presented with a wallet of treasury notes from the staff and foremen.

MR. T. H. POPE, of Epsom, who was for more than ten years lecturer in the brewing department of Birmingham University, died on January 14. He was a brother of Sir William Pope, the professor of chemistry at Cambridge: he graduated from Birmingham in 1904, and held the position of lecturer until after the war, when he took up bacteriological research for various distilleries.

MR. ALBERT LIDGETT, senior joint-editor and formerly proprietor of "The Petroleum Times," died at Croydon on January 7, aged 59. He served on Staffordshire newspapers before joining the "Oldham Standard" in 1897. Later he was editor of the "Croydon Chronicle," and in 1901 assumed control of "The Petroleum Times," of which he was editor and proprietor until last August.

LORD HIRST OF WITTON, chairman and joint managing director of the General Electric Co., asked by the Grand Council of the Federation to accept nomination as president of the Federation of British Industries for the coming year, has agreed to do so. The presidential year commences in April. Lord Hirst has, through his chairmanship of the Empire Committee in recent years, rendered signal service to the F.B.I. LORD ABERCONWAY, of Thos. Firth and John Brown, Ltd., and MR. A. H. KILNER, of Courtaulds, Ltd., have been nominated as additional vice-presidents of the Federation.

MR. H. J. MITCHELL, who, as briefly reported last week, has been appointed president of Imperial Chemical Industries, Ltd., in succession to the late Lord Reading, is one

of that small and select band who have risen to the highest positions in industry without becoming widely known to the general public. Yet few industrialists of the present day are better equipped or have a wider knowledge and experience of all aspects of trade and commerce.

Mr. Mitchell entered the service of the Nobel-Dynamite Trust on probation in 1893, and by steady advancement reached the position of secretary to the company in 1912. When the outbreak of war raised the problem of segregating the British and German interests of the Nobel Trust, Mr. Mitchell was appointed liquidator of the Trust Company and carried through the difficult negotiations which led to the final agreement covering the re-organisation, and in 1915 he joined the staff of the re-organised Nobel's Explosives Co., Ltd., as assistant general manager at the Glasgow headquarters. There then began an even more intimate association with Sir Harry McGowan than had existed in earlier years; incidentally, an association which has now lasted for over 36 years and is probably unique in industry. The immediate task was to face the problem of munition supply, in which the company naturally played such an important part, but an equally difficult task lay ahead in the question of what was to happen with the various companies engaged in the explosives and cognate trades when the war ended and competition re-asserted itself. After many months of negotiation, the solution was found in the formation in 1918 of a combination of the explosives and ammunition interests of Great Britain under the name of Explosives Trades, Ltd., later altered to Nobel Industries, Ltd. Sir Harry was appointed chairman and managing director and Mr. Mitchell general manager. In October, 1920, he joined the board of Nobel Industries, Ltd., and on the formation of Imperial Chemical Industries, Ltd., in 1926, in which he took no small part, he was elected one of its original directors. His knowledge has been of the greatest help to Sir Harry McGowan in the solution of the many problems which have from time to time faced the company. In spite of his many activities he has found time to travel extensively on the company's business, in North and South America, Africa, the Near East and on the Continent. Mr. Mitchell combines with his executive ability and a great capacity for work a personality which, added to his wide experience, provides the clue to his success as a negotiator.

THE LORD MAYOR OF LIVERPOOL is taking a personal interest in the arrangements for the annual meeting of the Society of Chemical Industry to be held at Liverpool from July 6 to 10. He will preside at an inaugural meeting at the Town Hall at noon on Monday next, in preparation for the July gatherings.



Photo: Janet Jeavons.

Mr. H. J. Mitchell.

Continental Chemical Notes

Denmark

TRANSPARENT WRAPPING PAPER under the brand name of "Danofan" is shortly to be produced by the Danish Transparent Acetate Film Foil Works (Datra) at an initial hourly output of 1,000 metres.

Poland

UNDER THE NAME OF SENNARCOL SODIUM, the firm of L. Spiess and Son, of Warsaw, is offering the sodium salt of methylcyclohexenyl methyl barbituric acid as a narcotic for intravenous injection.

Czecho-Slovakia

INCLUDED IN THE EXPANSION PROGRAMME of the Ossig Chemical and Metallurgical concern is a large dyestuffs works, which is now under construction. A total sum of 100 million kronen has been allocated for new developments.

Switzerland

THE MUNICIPALITY OF BERNE has decided upon the erection of a gas purifying plant at an outlay of 170,000 francs.

NEW COMPANY REGISTRATIONS include the following: Saprochi S.A., Geneva, capital 12,000 francs (pharmaceutical products); Adolf Suter et Cie, Schwyz (cosmetics and hygienic products); Javitan A.G., Zurich (cosmetics and pharmaceutical preparations).

Russia

CALCIUM SILICIDE is reported to have been produced in the ferro-chrome department of the Saporosch Steel Works, the first batch of 1,100 kg. being delivered on December 20, 1935.

MOTOR SPIRIT DERIVED FROM SHALE has been used in road trials between Moscow and Leningrad. Tests were carried out with two grades of spirit obtained respectively by direct distillation and hydrogenation of shale and the results compared favourably with those obtained with petroleum spirit.

Holland

A NEW MATCH MANUFACTURING CONCERN, N. V. National Lucifersfabrick, has been established at Amsterdam, with a capital of 250,000 guilders.

Hungary

FOLLOWING PROLONGED NEGOTIATIONS an agreement has finally been arrived at between the Snia Viscosa and Hungarian artificial silk interests, with a view to erecting a rayon factory. The Italian concern participates to the extent of 51 per cent., the remaining 49 per cent. of the shares being held by the Hungarian Discount Bank, the Hungarian Credit Bank and the Hungaria-Artificial Fertiliser Works.

Austria

AN ASSOCIATION OF BUTCHERS in Vienna is contemplating the erection of a soap works with a view to utilising waste fat products.

NEW COMPANY REGISTRATIONS include the following: E. and M. Holy, Vienna 12 (technical chemical manufacturers); Austrian Imbert-Wood Gas Generating Co., Vienna 10, capital 25,000 schillings (production and installation of plant for obtaining illuminating gas by wood distillation).

DISCUSSING THE PROSPECTS OF THE AUSTRIAN CHEMICAL INDUSTRY, J. Pollak, of the Skoda-Wetzler Powder Co., refers to the increased turnover achieved in the case of mineral acids and heavy chemicals including sodium carbonate and caustic soda. In the fine chemical industry the previous year's position was maintained. Taken as a whole, production in the chemical industry increased by 15 per cent., as compared with the previous year. Owing to the keen domestic demand, chlorine and chromium compounds were produced on a considerably larger scale while increased exports were secured in the case of caustic soda, calcium carbide, acetic acid, and hydrochloric acid and salicylic acid ("Die Chemische Industrie").

The Institute of Export Speeches at the Inaugural Meeting

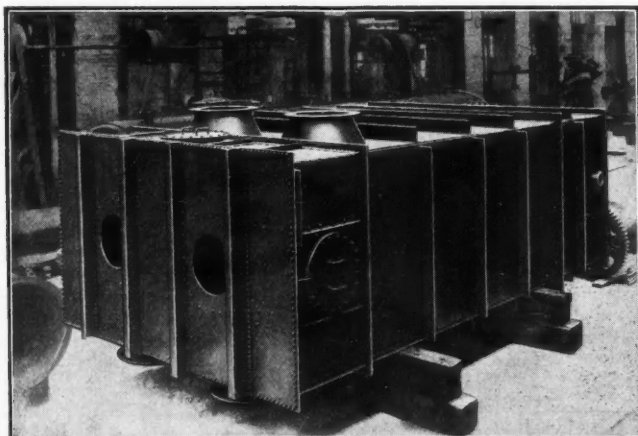
THE Institute of Export, the first professional organisation for those engaged in the British export trade, was inaugurated at the Cordwainers' Hall, London, on January 10. Sir Francis Goodenough, a vice-president of the Institute, presided, and was supported by the president, Major T. Knowles, Sir Ernest J. P. Benn, Bt., vice-president, Mr. R. Kelso, and Mr. W. V. Jenkins, secretary. A reception was provided by Lord Wakefield, who sent a message of goodwill in his unavoidable absence.

Sir FRANCIS GOODENOUGH described the objects and the constitution of the Institute. One of their principal objects, he said, was to establish export on a professional level with the aid of a body of export executives who had been functioning for the past twelve years as the British Export Society. The Society consisted exclusively of those actually handling export business, and experience had taught them that the export trade of this country was being handled by individuals working alone, without the benefit of a common fund of information and experience, and with the handicap of starting without the specialist training which other professions have found essential. The Institute, which was incorporated on November 16, 1935, filled a long-felt want, because the pressure of foreign competition and the multiplication of trade barriers had rendered export trade increasingly difficult, and because export management demanded a specialised technique. The primary objects of the Institute, said Sir Francis, were to further the interests of British

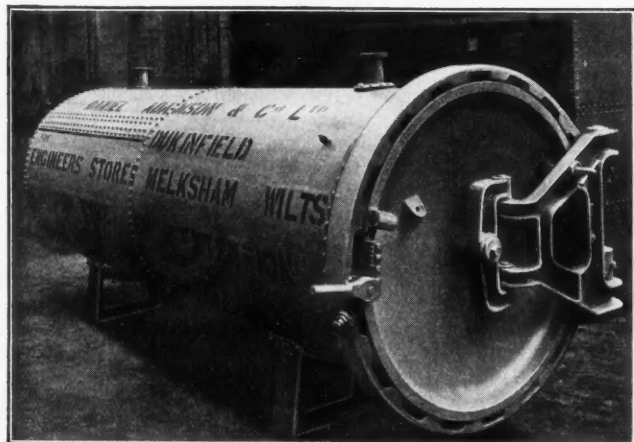
exporters and to give official recognition to export as a career of national importance; to watch over the interests and to improve the status of those engaged in export; to set suitable standards of export training and organise special export classes, and to publish information of service to exporters.

Sir ERNEST BENN said that as an individualist he judged a movement not by the prospectus it issued but by the men behind it. The Institute of Export had the active support of such men as Lord Hirst, Lord Meston, Sir Francis Goodenough, Sir Harry McGowan and Major Sir John Prestige. That short list was sufficient to vouch for the quality of the movement. Some of the aspects of the Institute had a special appeal for him, as, for instance, its big educational programme. In facilitating exports the Institute would undoubtedly stimulate our import trade, and could therefore be regarded as an institute of international trade. No doubt could exist in the mind of any sane person of the need of such an institute. The Institute's intention of establishing the professional status of the exporter must appeal to all. The professional status of the business man was the coming movement. The Advertising Association, of which he was president, was taking particular interest in the new Institute because it was following closely the methods which the Association had adopted with regard to education.

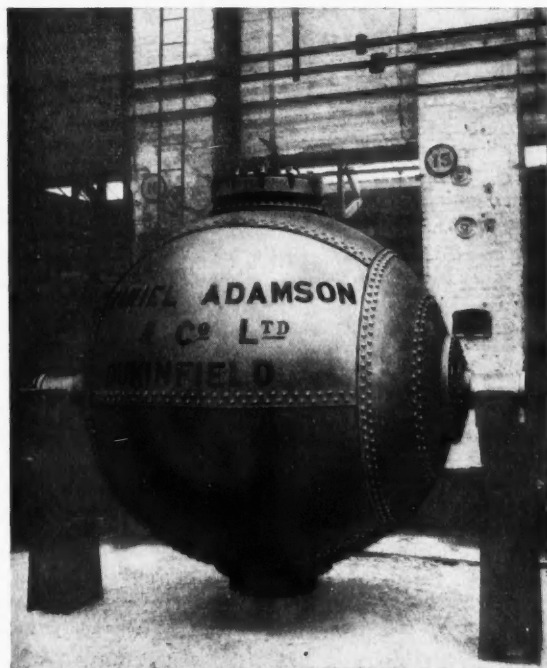
Manufacturers and exporters are invited to get in touch with the Secretary of the Institute, Mr. W. V. Jenkins, at 21 Tothill Street, S.W.1.



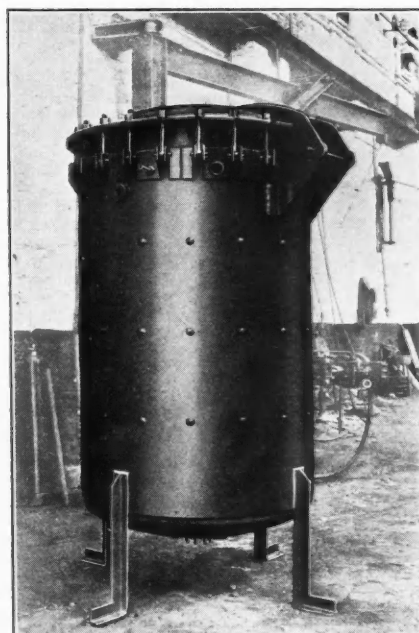
Mild Steel Riveted Precipitator, 20ft. x 12ft. x 6ft. 6in. deep, with welded-on tube plates, tested to $2\frac{1}{2}$ lb. per sq. in. air pressure.



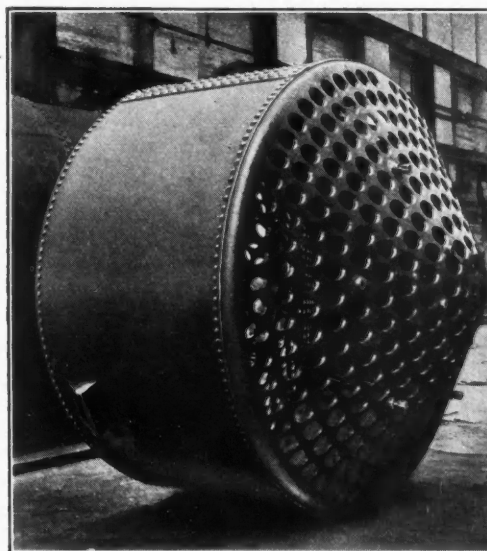
Horizontal Hydraulic Heater, 5ft. diam. x 15ft long, with boltless quick-sealing door, supported on two cradles.



Spherical Rag Boiler, 9ft. diam., with strengthening plates under trunnions, as supplied to a large paper mill.



Mild Steel Jacketed Vessel, 4ft. diam. x 6ft. 6in. deep, with top cover secured by 1in. swing bolts.



Mild Steel Calandria of riveted construction, 9ft. diam. x 7ft. deep, with cone-shaped tube plates pressed to 30° .

Tanks for All Purposes

A Specialised Service

IN order to keep abreast with the ever-increasing demands for fusion welded platework, Daniel Adamson and Co., Ltd., have installed the most modern plant. Typical examples of their work are shown in the accompanying illustrations, from which it will be noticed that they are able to make tanks and vessels in a wide variety of shapes and sizes. Either electric or acetylene welding processes are employed, and for riveted constructions a patent system of pin riveting can be used. Plant has been supplied for solvent oil extraction, oil refining, soap making, drying, evaporating, condensing, etc., expert technical knowledge being available to assist plant users in arriving at a design to meet their particular requirements.

Weekly Prices of British Chemical Products

Review of Current Market Conditions

Price Changes

General Chemicals.—SODIUM METASILICATE, £14 per ton; CADMIUM SULPHIDE, 5s. to 5s. 3d. per lb.
Wood Distillation Products.—ACETATE OF LIME, brown, £7 15s. to £8 15s. per ton; grey, £10 10s. to £11.
Pharmaceutical and Photographic Chemicals.—MENTHOL, A.B.R. recryst., B.P., 13s. 6d. per lb.
Perfumery Chemicals.—CINNAMIC ALDEHYDE, natural, 12s. per lb.; CITRAL, 6s. 6d.; GERANIOL, 4s. 3d. to 8s.; MUSK, ambrette 15s., ketone 14s. 9d., xylol 3s. 9d.

Essential Oils.—ANISE, 2s. 1d. per lb.; BOURBON GERANIUM, 22s. 9d.; CANANGA, Java, 11s. 6d.; CINNAMON OIL, Ceylon, 3s. 9d.; CASSIA, 80/85%, 5s.; CLOVE, 90/92% English, 4s. 6d.; LAVENDER, Mont Blanc, 38/40%, 26s.; ORANGE, sweet, 8s.; PEPPERMINT, English Mitcham, 55s., Japanese, 5s. 9d., Wayne County, 9s. 3d.; SANDALWOOD, English, 24s. 6d.

Intermediates.—NITRONAPHTHALENE, 9d. per lb.

All other prices remain unchanged.

SEVERAL price changes have been announced during the week in perfumery chemicals and essential oils, whilst in the wood distillation products section prices of acetate of lime have been reduced. There are no price change to report in the markets for coal tar products. Unless otherwise stated the prices below cover fair quantities net and naked at sellers' works.

LONDON.—Prices of chemical products in London remain very steady with quite a good general demand. Acetic acid, technical 40%, is now quoted at £17 15s. to £19 15s. per ton.

MANCHESTER.—The majority of the leading buyers of both light and heavy chemicals in the Manchester area have already covered their requirements for some months ahead, and consequently fresh contract bookings during the past week have been relatively few and for small quantities. A satisfactory feature is that exist-

ing commitments, on the whole, are being drawn against on a fairly satisfactory scale. In other directions a moderate spot and early delivery business has been put through this week and prices generally maintain a steady tone. With regard to the by-products, with the solitary exception of pyridine, the tone is extremely firm, especially in the light materials and the naphthalenes, though pitch and both crude and refined tar are in a strong position. The demand in this section has been active and supplies for early delivery are not easily obtainable in the case of a number of products.

SCOTLAND.—There has been an improved demand for chemicals for home trade during the week, though export inquiries have been rather limited. Prices generally continue very steady at about previous figures with only slight changes to report.

General Chemicals

ACETONE.—LONDON: £62 to £65 per ton; SCOTLAND: £66 to £68 ex wharf, according to quantity.

ACID, ACETIC.—LONDON: Tech., 80%, £33 5s. to £35 5s. per ton; pure 80%, £35 5s. to £37 5s.; tech., 40%, £17 15s. to £19 15s.; tech., 60%, £25 15s. to £27 15s. SCOTLAND: Glacial 98/100%, £48 to £52; pure 80%, £39 5s.; tech., 80%, £38 5s., d/d buyers' premises Great Britain. MANCHESTER: 80%, commercial, £37 5s.; tech. glacial, £50.

ACID, BORIC.—Commercial granulated, £27 per ton; crystal, £28; powdered, £29; extra finely powdered, £31; packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. B.P. cryst., £36; B.P. powder, £37. SCOTLAND: Crystals, £28; powdered, £29.

ACID, CHROMIC.—10½d. per lb., less 2½%, d/d U.K.

ACID, CITRIC.—11½d. per lb. MANCHESTER: 11½d. to 1s. SCOTLAND: 11½d.

ACID, CRESYLIC.—97/100%, 1s. 5d. to 1s. 6d. per gal.; 99/100%, refined, 1s. 9d. to 1s. 10d. per gal. LONDON: 98/100%, 1s. 5d. f.o.r.; dark, 1s.

ACID, FORMIC.—LONDON: £42 to £47 per ton.

ACID, HYDROCHLORIC.—Spot, 4s. to 6s. carboy d/d according to purity, strength and locality. SCOTLAND: Arsenical quality, 4s.; dearsenicated, 5s. ex works, full wagon loads.

ACID, LACTIC.—LANCASHIRE: Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £48; pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £53; edible, 50% by vol., £41. One-ton lots ex works, barrels free.

ACID, NITRIC.—80° Tw. spot, £18 to £25 per ton makers' works. SCOTLAND: 80°, £24 ex station full truck loads.

ACID, OXALIC.—LONDON: £47 17s. 6d. to £57 10s. per ton, according to packages and position. SCOTLAND: 98/100%, £48 to £50 ex store. MANCHESTER: £49 to £54 ex store.

ACID, SULPHURIC.—SCOTLAND: 144° quality, £3 12s. 6d.; 168°, £7; dearsenicated, 20s. per ton extra.

ACID, TARTARIC.—1s. per lb. less 5%, carriage paid for lots of 5 cwt. and upwards. LONDON: 11½d., less 5%. SCOTLAND: 1s. 6½d. less 5%. MANCHESTER: 1s. per lb.

ALUM.—SCOTLAND: Lump potash, £8 10s. per ton ex store

ALUMINA SULPHATE.—LONDON: £7 10s. to £8 per ton. SCOTLAND: £7 to £8 ex store.

AMMONIA, ANHYDROUS.—Spot, 10d. per lb. d/d in cylinders. SCOTLAND: 10d. to 1s. containers extra and returnable.

AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.

AMMONIUM BICARBONATE.—8d. per lb. d/d U.K.

AMMONIUM CARBONATE.—SCOTLAND: Lump, £30 per ton; powdered, £33, in 5-cwt. casks d/d buyers' premises U.K.

AMMONIUM CHLORIDE.—LONDON: Fine white crystals, £18 to £19. (See also Salammianic.)

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammianic.)

ANTIMONY OXIDE.—SCOTLAND: £61 to £65 per ton, c.i.f. U.K. ports.

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 1d. per lb.; crimson, 1s. 5½d. to 1s. 7d. per lb., according to quality.

ARSENIC.—LONDON: £15 per ton c.i.f. main U.K. ports for imported material; Cornish nominal, £22 10s. f.o.r. mines. SCOTLAND: White powdered, £23 ex wharf. MANCHESTER: White powdered Cornish, £22, ex store.

ARSENIC SULPHIDE.—Yellow, 1s. 5d. to 1s. 7d. per lb.

BARIUM CHLORIDE.—LONDON: £10 10s. per ton. SCOTLAND: £10 10s. to £10 15s.

BARYTES.—£6 10s. to £8 per ton.

BISULPHITE OF LIME.—£6 10s. per ton f.o.r. London.

BLEACHING POWDER.—Spot, 35/37%, £7 19s. per ton d/d station in casks, special terms for contract. SCOTLAND: £9 5s.

BORAX, COMMERCIAL.—Granulated, £14 10s. per ton; crystal, £15 10s.; powdered, £16; finely powdered, £17; packed in 1-cwt. bags, carriage paid home to buyer's premises within the United Kingdom in 1-ton lots.

CADMIUM SULPHIDE.—5s. to 5s. 3d.

CALCIUM CHLORIDE.—Solid 70/75% spot, £5 5s. per ton d/d station in drums.

CARBON BISULPHIDE.—£31 to £33 per ton, drums extra.

CARBON BLACK.—3½d. to 4½d. per lb. LONDON: 4½d. to 5d.

CARBON TETRACHLORIDE.—SCOTLAND: £41 to £43 per ton, drums extra.

CHROMIUM OXIDE.—10½d. per lb., according to quantity d/d U.K.; green, 1s. 2d. per lb.

CHROMETAN.—Crystals, 3½d. per lb.; liquor, £19 10s. per ton d/d.

COPPERAS (GREEN).—SCOTLAND: £3 15s. per ton, f.o.r. or ex works.

CREAM OF TARTAR.—£3 19s. per cwt. less 2½%. LONDON: £3 17s. per cwt. SCOTLAND: £3 16s. 6d. net.

DINITROTOLUENE.—66/68° C., 9d. per lb.

DIPHENYLGUANIDINE.—2s. 2d. per lb.

FORMALDEHYDE.—LONDON: £24 10s. per ton. SCOTLAND: 40%, £25 to £28 ex store.

IODINE.—Resublimed B.P., 6s. 3d. to 8s. 4d. per lb.

LAMPBLACK.—£45 to £48 per ton.

LEAD ACETATE.—LONDON: White, £36 10s. per ton; brown, £1 per ton less. SCOTLAND: White crystals, £34 to £35; brown, £1 per ton less. MANCHESTER: White, £36; brown, £35 10s.

LEAD NITRATE.—£32 10s. to £34 10s. per ton.

LEAD, RED.—SCOTLAND: £25 to £27 per ton less 2½%; d/d buyer's works.

LEAD, WHITE.—SCOTLAND: £39 per ton, carriage paid. LONDON: £42 10s.

LITHOPONE.—30%, £16 10s. to £17 per ton.

MAGNESITE.—SCOTLAND: Ground calcined, £9 per ton, ex store.

MAGNESIUM CHLORIDE.—SCOTLAND: £7 per ton.

MAGNESIUM SULPHATE.—Commercial, £5 per ton, ex wharf.

METHYLATED SPIRIT.—61 O.P. industrial, 1s. 5d. to 2s. per gal.; pyridinised industrial, 1s. 7d. to 2s. 2d.; mineralised, 2s. 6d.

to 3s. Spirit 64 O.P. is 1d. more in all cases and the range of prices is according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

PHENOL.—6½d. to 7½d. per lb. to June 30, 1936.

POTASH, CAUSTIC.—LONDON: £42 per ton. MANCHESTER: £39.

POTASSIUM BICHROMATE.—Crystals and Granular, 5d. per lb. less 5%, d/d U.K. Ground, 5½d. LONDON: 5d. per lb. less 5%, with discounts for contracts. SCOTLAND: 5d. d/d U.K. or c.i.f. Irish Ports. MANCHESTER: 5d.

POTASSIUM CHLORATE.—LONDON: £37 to £40 per ton. SCOTLAND: 99½/100%, powder, £37. MANCHESTER: £38.

POTASSIUM CHROMATE.—6½d. per lb. d/d U.K.

POTASSIUM IODIDE.—B.P., 5s. 2d. per lb.

POTASSIUM NITRATE.—SCOTLAND: Refined granulated, £29 per ton c.i.f. U.K. ports. Spot, £30 per ton ex store.

POTASSIUM PERMANGANATE.—LONDON: 8½d. per lb. SCOTLAND: B.P. crystals, 10d. to 10½d. MANCHESTER: B.P., 11½d.

POTASSIUM PRUSSIAN.—LONDON: Yellow, 8½d. to 8½d. per lb. SCOTLAND: Yellow spot, 8½d. ex store. MANCHESTER: Yellow, 8½d.

SALAMMONIAC.—First lump spot, £41 17s. 6d. per ton d/d in barrels. SCOTLAND: Large crystals, in casks, £36.

SODA ASH.—58% spot, £5 12s. 6d. per ton f.o.r. in bags.

SODA, CAUSTIC.—Solid, 76/77° spot, £13 17s. 6d. per ton d/d station. SCOTLAND: Powdered 98/99%, £17 10s. in drums, £18 5s. in casks, Solid 76/77°, £14 12s. 6d. in drums; 70/73%, £14 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts 10s. per ton less. MANCHESTER: £13 5s. to £14 contracts.

SODA CRYSTALS.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

SODIUM ACETATE.—LONDON: £21 10s. SCOTLAND: £20 15s.

SODIUM BICARBONATE.—Refined spot, £10 10s. per ton d/a station in bags. SCOTLAND: Refined recrystallised £10 15s. ex quay or station. MANCHESTER: £10 10s.

SODIUM BICHROMATE.—Crystals cake and powder 4d. per lb. net d/d U.K. discount 5%. Anhydrous, 5d. per lb. LONDON: 4d. per lb. less 5% for spot lots and 4d. per lb. with discounts for contract quantities. MANCHESTER: 4d. per lb. basis. SCOTLAND: 4d. delivered buyer's premises with concession for contracts.

SODIUM BISULPHITE POWDER.—60/62%, £20 per ton d/d 1 cwt. iron drums for home trade.

SODIUM CARBONATE, MONOHYDRATE.—£15 per ton d/d in minimum ton lots in 2 cwt. free bags. Soda crystals, SCOTLAND: £5 to £5 5s. per ton ex quay or station. Powdered or pea quality, 7s. 6d. per ton extra. Light Soda Ash, £7 ex quay, min. 4-ton lots with reductions for contracts.

SODIUM CHLORATE.—£31 per ton. SCOTLAND: 3½d. per lb.

SODIUM CHROMATE.—4d. per lb. d/d U.K.

SODIUM HYPOSULPHITE.—SCOTLAND: Large crystals English manufacture, £9 5s. per ton ex stations, min. 4-ton lots. Pea crystals, £14 10s. ex station, 4-ton lots. MANCHESTER: Commercial, £10 5s.; photographic, £14 10s.

SODIUM METASILICATE.—£14 per ton, d/d U.K. in cwt. bags.

SODIUM IODIDE.—B.P., 6s. per lb.

SODIUM NITRITE.—LONDON: Spot, £18 5s. to £20 5s. per ton d/d station in drums.

SODIUM PERBORATE.—10%, 9½d. per lb. d/d in 1-cwt. drums. LONDON: 10d. per lb.

SODIUM PHOSPHATE.—£13 per ton.

SODIUM PRUSSIAN.—LONDON: 5d. to 5½d. per lb. SCOTLAND: 5d. to 5½d. ex store. MANCHESTER: 5d. to 5½d.

SODIUM SILICATE.—140° Tw. Spot, £8 per ton. SCOTLAND: £8 10s.

SODIUM SULPHATE (GLAUBER SALTS).—£4 2s. 6d. per ton d/d SCOTLAND: English material, £3 15s.

SODIUM SULPHATE (SALT CAKE).—Unground spot, £3 12s. 6d. per ton d/d station in bulk. SCOTLAND: Ground quality, £3 per ton d/d. MANCHESTER: £3 5s.

SODIUM SULPHIDE.—Solid 60/62% Spot, £10 15s. per ton d/a in drums; crystals 30/32%, £8 per ton d/d in casks. SCOTLAND: For home consumption, Solid 60/62%, £10 5s.; broken 60/62%, £11 5s.; crystals, 30/32%, £8 7s. 6d. d/d buyer's works on contract, min. 4-ton lots. Spot solid, 5s. per ton extra. Crystals, 2s. 6d. per ton extra. MANCHESTER: Concentrated solid, 60/62%, £11; commercial, £8 2s. 6d.

SODIUM SULPHITE.—Pea crystals, spot, £13 10s. per ton d/d station in kegs. Commercial spot, £8 15s. d/d station in bags.

SULPHUR.—£9 10s. to £9 15s. per ton. SCOTLAND: £8 to £9.

SULPHATE OF COPPER.—MANCHESTER: £14 17s. 6d. to £16 per ton f.o.b.

SULPHUR CHLORIDE.—5d. to 7d. per lb., according to quality.

SULPHUR PRECIP.—B.P., £55 to £60 per ton according to quantity. Commercial, £50 to £55.

VERMILION.—Pale or deep, 5s. 1d. per lb. in 1-cwt. lots.

ZINC CHLORIDE.—SCOTLAND: British material, 98%, £18 10s. per ton f.o.b. U.K. ports.

ZINC SULPHATE.—LONDON: £12 per ton. SCOTLAND: £10 10s.

ZINC SULPHIDE.—10d. to 11d. per lb.

Coal Tar Products

ACID, CRESYLIC.—90/100%, 2s. to 2s. 8d. per gal., according to specification; pale 98%, 1s. 10d. to 1s. 11d.; dark, 1s. 6d. to 1s. 7d. LONDON: 98/100%, 1s. 4d.; dark, 95/97%, 1s.

SCOTLAND: Pale, 99/100%, 1s. 3d. to 1s. 4d.; dark, 97/99%, 1s. to 1s. 1d.; high boiling acid, 2s. 6d. to 3s.

ACID, CARBOLIC.—Crystals, 6½d. to 7½d. per lb.; crude, 60's, 1s. 11½d. to 2s. 2½d. per gal. MANCHESTER: Crystals, 7½d. to 7½d. per lb.; crude, 2s. 7d. per gal. SCOTLAND: 60's, 2s. 6d. to 2s. 7d.

BENZOL.—At works, crude, 9½d. to 10d. per gal.; standard motor 1s. 3d. to 1s. 3½d.; 90%, 1s. 4d. to 1s. 4½d.; pure, 1s. 7½d. to 1s. 8d. LONDON: Motor, 1s. 3½d. SCOTLAND: Motor, 1s. 6½d.

CREOSOTE.—B.S.I. Specification standard, 5½d. per gal. f.o.r. Home, 3½d. d/d. LONDON: 4½d. f.o.r. North; 5d. London. MANCHESTER: 5½d. SCOTLAND: Specification oils, 4d.; washed oil, 4½d. to 4½d.; light, 4½d.; heavy, 4½d. to 4½d.

NAPHTHA.—Solvent, 90/100%, 1s. 5½d. to 1s. 6½d. per gal.; 95/160%, 1s. 9d.; 90%, 11d. to 1s. 1d. LONDON: Solvent, 1s. 3½d. to 1s. 4d.; heavy, 11d. to 1s. 0½d. f.o.r. SCOTLAND: 90/160%, 1s. 3d. to 1s. 3½d.; 90/190%, 11d. to 1s. 2d.

NAPHTHALENE.—Crude, whizzed or hot pressed, £12 15s. per ton; purified crystals, £15 5s. per ton in 2-cwt. bags. LONDON: Fire lighter quality, £3 to £3 10s.; 74/76 quality, £4 to £4 10s.; 76/78 quality, £5 10s. to £6. SCOTLAND: 40s. to 50s.; whizzed, 70s. to 75s.

PYRIDINE.—90/140%, 5s. 6d. to 8s. per gal.; 90/180, 2s. 3d.

TOLUOL.—90%, 2s. 3d. to 2s. 4d. per gal.; pure, 2s. 6d. to 2s. 7d.

XYLOL.—Commercial, 2s. 3d. per gal.; pure, 2s. 4d.

PITCH.—Medium, soft, 35s. to 36s. per ton, in bulk at makers' works. MANCHESTER: 47s. 6d. f.o.b., East Coast.

Intermediates and Dyes

ACID, BENZOIC, 1914 B.P. (ex Toluol).—1s. 9½d. per lb.

ACID, GAMMA.—Spot, 4s. per lb. 100% d/d buyer's works.

ACID, H.—Spot, 2s. 4½d. per lb. 100% d/d buyer's works.

ACID NAPHTHIONIC.—1s. 8d. per lb.

ACID, NEVILLE AND WINTHER.—Spot, 3s. per lb. 100%.

ACID, SULPHANILIC.—Spot, 8d. per lb. 100%, d/d buyer's works.

ANILINE OIL.—Spot, 8d. per lb., drums extra, d/d buyer's works.

ANILINE SALTS.—Spot, 8d. per lb. d/d buyer's works, casks free.

BENZALDEHYDE.—Spot, 1s. 8d. per lb., packages extra.

BENZIDINE BASE.—Spot, 2s. 5d. per lb., 100% d/d buyer's works.

BENZIDINE HCL.—2s. 5d. per lb.

p-CRESOL 34.5° C.—1s. 9d. per lb. in ton lots.

m-CRESOL 98/100%.—1s. 11d. per lb. in ton lots.

DICHLORANILINE.—1s. 11½d. to 2s. 3d. per lb.

DIMETHYLANILINE.—Spot, 1s. 6d. per lb., package extra.

DINITROBENZENE.—8d. per lb.

DINITROTOLUENE.—48/50° C., 9d. per lb.; 66/68° C., 10½d.

DINITROCHLOROBENZENE, SOLID.—£72 per ton.

DIPHENYLAMINE.—Spot, 2s. per lb., d/d buyer's works.

α-NAPHTHOL.—Spot, 2s. 4d. per lb., d/d buyer's works.

β-NAPHTHOL.—Spot, £78 15s. per ton, in paper bags.

α-NAPHTHYLAMINE.—Spot, 11½d. per ton., d/d buyer's works.

β-NAPHTHYLAMINE.—Spot, 2s. 9d. per lb., d/d buyer's works.

o-NITRANILINE.—3s. 11d. per lb.

m-NITRANILINE.—Spot, 2s. 7d. per lb., d/d buyer's works.

p-NITRANILINE.—Spot, 1s. 8d. per lb., d/d buyer's works.

NITROBENZENE.—Spot, 4½d. to 5d. per lb.; 5-cwt. lots, drums extra.

NITRONAPHTHALENE.—9d. per lb.; P.G., 1s. 0½d. per lb.

SODIUM NAPHTHIONATE.—Spot, 1s. 9d. per lb.

o-TOLUIDINE.—9½d. to 11d. per lb.

p-TOLUIDINE.—1s. 11d. per lb.

Wood Distillation Products

ACETATE OF LIME.—Brown, £7 15s. to £8 15s. per ton; grey, £10 10s. to £11. Liquor, brown, 30° Tw., 8d. per gal. MANCHESTER: Brown, £9 10s.; grey £11 10s.

CHARCOAL.—£4 15s. to £10 per ton, according to grade and locality.

METHYL ACETONE.—40-50%, £43 to £46 per ton.

WOOD CREOSOTE.—Unrefined, 3d. to 1s. 3d. per gal.

WOOD NAPHTHA, MISCIBLE.—2s. 6d. to 3s. 6d. per gal.; solvent, 3s. 3d. to 4s. 3d. per gal.

WOOD TAR.—£2 to £2 10s. per ton.

Latest Oil Prices

LONDON, Jan. 15.—LINSEED OIL was steady. Spot, £29 10s. (small quantities); Jan., £27; Jan.-April, £27 5s.; May-Aug., £27 10s.; Sept.-Dec., £27 17s. 6d. naked. RAPE OIL was slow. Crude extracted, £35 10s.; technical refined, £37, naked, ex wharf. COTTON OIL was quiet. Egyptian crude, £25 10s.; refined, common edible, £29; deodorised, £31, naked, ex mill (small lots £1 10s. extra). TURPENTINE was quiet. American spot, 44s. 9d. per cwt.

HULL.—LINSEED OIL, spot, quoted £27 15s. per ton; Jan., £27 5s.; Jan.-April, £27 7s. 6d.; May-Aug., £27 10s. COTTON OIL, Egyptian, crude, spot, £25 10s.; edible, refined, spot, £28 10s.; technical spot, £28 10s.; deodorised, £30 10s., naked. PALM KERNEL OIL, crude, f.m.q., spot, £25, naked. GROUNDNUT OIL, extracted, spot, £32; deodorised, £35. RAPE OIL, extracted, spot, £34 10s.; refined, £36. SOYA OIL, extracted, spot, £27; deodorised, £30 per ton. COD OIL, f.o.r. or f.a.s., 25s. per cwt. in barrels. CASTOR OIL, pharmaceutical, 43s. 6d. per cwt.; firsts, 38s. 6d.; seconds, 36s. 6d. TURPENTINE, American, spot, 46s. 3d. per cwt.

Chemical and Allied Stocks and Shares

Broadening of Interest in Most Sections

Fison, Packard and Prentice were prominently active and United Molasses attracted considerable attention at higher prices. There are expectations in the market that the latter company may resume paying an interim dividend this year. If this is the case the announcement is not likely before March. British Glues retained the higher price made in the previous week. There are also anticipations of a possible interim payment in this case. Imperial Chemical Industries have been steady, awaiting the conversion of the deferred shares into ordinary shares. Although the belief continues in the market that the dividend will be maintained at 8 per cent., the ordinary shares continue to offer a yield of fully 4½ per cent., which is nearly 1 per cent. more than that offered by many other leading industrial shares. A point of interest was the development of active business in B. Laporte which have moved up on the week from 115s. to close on 130s. at the time of writing. This reflects confirmation of hopes that the directors would follow a more liberal policy and distribute a bonus. The last results showed earnings of fully 49 per cent. on the shares, but the dividend was limited to 20 per cent. Cooper, McDougall & Robertson were unchanged, but showed little business, judged by recorded dealings. The list price for Salt Union has now been adjusted to the dealings at higher prices and the shares have remained active. Goodlass Wall & Lead Industries continued to attract attention on the hope that the dividend for the year may be increased to 7½ per cent. and that profits are benefiting from the new products of the lead section of the business. Distillers were higher, the market having been prepared for the maintenance of the interim dividend and for all question of an increase to be left until the final payment. There was again more business reported in British Drug Houses on

a wider recognition of the satisfactory yield offered and the belief that the dividend will be maintained at 5 per cent. for the year. The price of the shares has improved from 17s. 6d. to 18s. 1½d. at the time of writing. Dorman Long issues were very firm. Unilever were less prominent, but held practically all their good advance of the previous week. Although Triplex Safety Glass fluctuated somewhat sharply they continued to attract a good deal of business on the anticipations of an eventual bonus and on the possibility of interim dividends being resumed in March. Monsanto Chemical 5½ per cent. preference were unchanged. At the time of writing there is a line of the latter available in the market at 23s. 6d. The company is expected to publish its results for the past year in March. British Cyanides transferred very freely but have the same price as a week ago. British Oxygen were prominent with a sharp rise on balance for the week. The demand is attributed to the continued anticipations in the market that a bonus is in prospect. Associated Portland Cement units were also in demand on the possibility of some form of bonus or a favourable increase in dividend. British Oil & Cake Mills preferred were firm and United Premier Oil & Cake held up quite well with buyers reported on any reaction. Boots Pure Drug moved up, it being stated in the market that the remaining block of the shares hitherto held in America have now been satisfactorily marketed. There was again a good deal of interest shown in the 5s. ordinary shares of South African Druggists. It may be recalled that the recently-issued prospectus mentioned that the company's products are used by the majority of the big Rand mining concerns and by the Government railway and defence services. Anglo-Iranian and other leading oil shares have moved up sharply.

Name.	Jan. 14.	Jan. 7.
Anglo-Iranian Oil Co., Ltd. Ord.	79/1½	70/-
" 8% Cum. Pref.	37/-	36/6
" 9% Cum. Pref.	38/-	37/6
Associated Dyers and Cleaners, Ltd. Ord.	1/10½	1/10½
" 6½% Cum. Pref.	5/6½	5/6½
Associated Portland Cement Manufacturers, Ltd. Ord.	70/-	68/-
" 5½% Cum. Pref.	28/-	28/-
Benzol & By-Products, Ltd. 6% Cum. Part Pref.	2/6	2/6
Berger (Lewis) & Sons, Ltd. Ord.	66/3	66/3
Bleachers' Association, Ltd. Ord.	6/10½	7/6
" 5½% Cum. Pref.	12/2½	10/7½
Boake, A., Roberts & Co., Ltd. 5% Pref. (Cum.)	20/-	20/-
Boots Pure Drug Co., Ltd. Ord. (5/-)	53/9	50/-
Borax Consolidated, Ltd., Pfd. Ord. (£) ...	107/6	105/-
" Defd. Ord.	22/6	21/3
" 5½% Cum. Pref. (£100)	£11/15/-	£11/12/6
" 4½% Deb. (1st Mort.) Red. (£100)	£107	£107
" 4½% 2nd Mort. Deb. Red. (£100)	£103/10/-	£102/10/-
Bradford Dyers' Association, Ltd. Ord. ...	8/9	10/-
" 5% Cum. Pref.	13/1½	13/1½
" 4% 1st Mort. Perp. Deb. (£100)	£87/10/-	£87
British Celanese, Ltd. 7% 1st Cum. Pfd.	25/9	25/6
" 7½% Part. 2nd Cum. Pref.	23/9	23/6
British Cotton & Wool Dyers' Association Ltd. Ord. (5/-)	6/3	6/3
" 4% 1st Mort. Deb. Red. (£100)	£94	£94
British Cyanide Co., Ltd. Ord. (2/-)	3/1½	3/1½
British Drug Houses, Ltd. Ord.	18/1½	17/6
" 5% Cum. Pref.	21/10½	21/10½
British Glues and Chemicals, Ltd. Ord. (4/-)	8/1½	8/1½
" 8% Pref. (Cum. and Part.) ...	28/9	28/9
British Oil and Cake Mills, Ltd. Cum. Pfd. Ord.	48/9	48/9
" 5½% Cum. Pref.	25/7½	26/3
" 4½% First Mort. Deb. Red. (£100)	£107/10/-	£107/10/-
British Oxygen Co., Ltd. Ord.	120/-	115/-
" 6½% Cum. Pref.	32/6	32/6
British Portland Cement Manufacturers, Ltd. Ord.	85/-	85/-
" 6% Cum. Pref.	30/6	30/6
Bryant & May, Ltd. Pref.	66/3	66/3
Burt, Boulton & Haywood, Ltd. Ord.	20/-	20/-
" 7% Cum. Pref.	27/6	27/6
" 6% 1st Mort. Deb. Red. (£100)	£102/10/-	£102/10/-
Bush, W. J., & Co., Ltd. 5% Cum. Pref. (£5)	112/6	112/6
" 4% 1st Mort. Deb. Red. (£100)	£96/10/-	£96/10/-
Calico Printers' Association, Ltd. Ord. ...	8/9	8/9
" 5% Pref. (Cum.)	15/7½	15/7½

Name.	Jan. 14.	Jan. 7.
Cellulose Acetate Silk Co., Ltd. Ord.	14/8½	14/-
" Deferred (1/-)	2/10½	2/1½
Consett Iron Co., Ltd. Ord.	11/-	11/-
" 8% Pref.	31/3	30/-
" 6% First Deb. stock, Red. (£100)	£107	£107
Cooper, McDougall & Robertson, Ltd. Ord.	40/-	38/9
" 7% Cum. Pref.	30/-	30/-
Courtaulds, Ltd. Ord.	59/4½	60/-
" 5% Cum.	26/3	26/3
Crosfield, Joseph, & Sons, Ltd. 5% Cum. Pre-Pref.	25/-	25/-
" Cum. 6% Pref.	28/9	28/9
" 6½% Cum. Pref.	31/10½	31/10½
" 7½% "A" Cum. Pref.	30/-	32/6
Distillers Co., Ltd. Ord.	100/-	98/-
" 6% Pref. Stock Cum.	31/6	31/6
Dorman Long & Co., Ltd. Ord.	21/3	21/3
" Pref. Ord.	31/10½	31/3
" 6½% Non-Cum. 1st Pref.	23/-	23/-
" 8% Non-Cum. 2nd Pref.	24/-	24/3
" 4% First Mort. Perp. Deb. (£100)	£101/10/-	£101/10/-
" 5% 1st Mort. Red. Deb. (£100)	£106/10/-	£106/11/-
English Velvet & Cord Dyers' Association, Ltd. Ord.	4/4½	5/-
" 5% Cum. Pref.	8/9	8/9
" 4% First Mort. Deb. Red. (£100)	£72/10/-	£72/10/-
Fison, Packard & Prentice, Ltd. Ord.	45/7½	45/7½
" 7% Non-Cum. Pref.	31/3	31/3
" 4½% Debs. (Reg.) Red. (£100)	£106	£106
Gas Light & Coke Co. Ord.	27/6	27/6
" 3½% Maximum Stock (£100) ...	£90/10/-	£89/10/-
" 4% Consolidated Pref. Stock (£100)	£108/10/-	£108/10/-
" 3% Consolidated Deb. Stock, Irred. (£100)	£90/10/-	£90
" 5% Deb. Stock Red. (£100) ...	£116/10/-	£116/10/-
" 4½% Red. Deb. Stock (1960-65) (£100)	£114/10/-	£113/10/-
Goodlass Wall & Lead Industries, Ltd. Ord. (10/-)	14/4½	14/4½
" 7% Prefd. Ord. (10/-)	13/9	13/9
" 7% Cum. Pref.	28/9	28/9
Gossage, William, & Sons, Ltd. 5% 1st Cum. Pref.	24/4½	24/4½
" 6½% Cum. Pref.	28/9	28/9
Imperial Chemical Industries, Ltd. Ord. ...	37/-	37/3
" Deferred (10/-)	9/-	9/1½
" 7% Cum. Pref.	34/-	34/-
Imperial Smelting Corporation, Ltd. Ord.	15/9	15/9
" 6½% Pref. (Cum.)	25/-	24/3
International Nickel Co. of Canada, Ltd. Cum.	\$46½	\$45

Name.	Jan. 14.	Jan. 7.	Name.	Jan. 14.	Jan. 7.
Johnson, Matthey & Co., Ltd. 5% Cum. Pref. (£5)	105/-	105/-	Reckitt & Sons, Ltd. Ord.	115/7½	115/7½
" 4% Mort. Deb. Red. (£100)	£98/10/-	£98/10/-	" 4½% Cum. 1st Pref.	24/4½	24/4½
Laporte, B., Ltd. Ord.	128/9	115/-	Salt Union, Ltd. Ord.	47/6	43/9
Lawes Chemical Co., Ltd. Ord. (1/-)	6/3	6/3	" Pref.	47/6	45/-
" 7% Non-Cum. Part Pref. (10/-)	10/-	10/-	" 4½% Deb. (£100)	£107/10/-	£107/10/-
Lever Bros., Ltd. 7% Cum. Pref.	32/3	32/6	South Metropolitan Gas Co. Ord. (£100) ...	£134/10/-	£133/10/-
" 8% Cum. "A" Pref.	33/6	33/9	" 6% Irred. Pref. (£100)	£150/10/-	£149/10/-
" 20% Cum. Prefd. Ord.	78/1½	77/6	" 4% Pref. (Irred.) (£100)	£107	£107
" 5% Cons. Deb. (£100)	£107/10/-	£106/10/-	" Perpetual 3% Deb. (£100)	£88/10/-	£88/10/-
" 4% Cons. Deb. (£100)	£105/10/-	£105/10/-	" 5% Red. Deb. 1950-60 (£100)	£114/10/-	£114/10/-
Magadi Soda Co., Ltd. 12½% Pref. Ord. (5/-)	1/3	1/3	Staveley Coal and Iron Co., Ltd. Ord.	47/6	47/6
" 6% 2nd Pref. (5/-)	6d.	6d.	Stevenson & Howell, Ltd. 6½% Cum. Pref.	26/3	26/3
" 6% 1st Debs. (Reg.)	£40	£40	Triplex Safety Glass Co., Ltd. Ord. (10/-) ...	88/1½	89/4½
Major & Co., Ltd. Ord. (5/-)	7½d.	7½d.	Unilevers, Ltd. Ord.	32/6	32/6
" 8% Part. Prefd. Ord. (10/-) ...	9d.	9d.	" 7% Cum. Pref.	30/3	30/3
" 7½% Cum. Pref.	1/6½	1/6½	United Glass Bottle Manufacturers, Ltd. Ord.	40/-	42/6
Pinchin, Johnson & Co., Ltd. Ord. (10/-) ..	42/6	42/6	" 7½% Cum. Pref.	32/6	32/6
" 1st Pref. 6½% Cum.	32/-	32/-	United Molasses Co., Ltd. Ord. (6/8)	25/-	22/6
Potash Syndicate of Germany (Deutsches Kalisyndikat G.m.b.H.) 7% Gld. Ln. Sr. "A" and "B" Rd.	£72	£72	" 6% Cum. Pref.	25/-	25/-
			United Premier Oil & Cake Co., Ltd. Ord. (5/-)	10/6	10/9
			" 7% Cum. Pref.	25/-	25/-
			" 4½% Deb. Red. (£100)	£101/10/-	£101/10/-

Inventions in the Chemical Industry

Patent Specifications and Applications

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Open to Public Inspection

AQUEOUS BITUMINOUS EMULSIONS, process for production.—Aktieselskabet for Kemisk Industri. June 29, 1934. 6492/35.

DEWAXING HYDROCARBON OILS, method and apparatus.—Alco Products, Inc. June 29, 1934. 14633-4/35.

MAGNESIUM SULPHATE with a low water content or in the anhydrous condition, process and apparatus for production.—Metallges. A.-G. June 26, 1934. 17598/35.

POLYHYDRIC ALCOHOL-POLYBASIC ACID RESIN, production.—I. Rosenblum. June 27, 1934. 17886/35.

BERYLLIUM ALLOYS, manufacture.—Beryllium Corporation. June 26, 1934. 17983/35.

ENCLOSURES FOR CHEMICAL TREATMENTS in the gaseous phase by catalysis.—Soc. Française de Catalyse Généralisée. June 25, 1934. 18078/35.

MONOAZO DYESTUFFS, manufacture.—I. G. Farbenindustrie. June 29, 1934. 18516/35.

AMINES, manufacture.—E. I. du Pont de Nemours and Co. June 28, 1934. 18619/35.

BASIC TRIPHENYLMETHANE DYESTUFFS, manufacture.—I. G. Farbenindustrie. June 30, 1934. 18767/35.

REMOVAL OF HYDROGEN SULPHIDE and other sulphur compounds from gases, especially coal-distillation gases, process.—H. Koppers' Industriele Maatschappij Naamloze Vennootschap. June 29, 1934. 18819/35.

Specifications Accepted with Date of Application

KETONES OF THE ANTHRACENE SERIES, manufacture and production.—Coutts and Co. and F. Johnson (I. G. Farbenindustrie). June 18, 1934. 440,263.

NITROCELLULOSE, manufacture.—E. I. du Pont de Nemours and Co. June 21, 1933. 440,203.

MIXTURES CONTAINING DICHLOROBENZENES, treatment.—N. Bennett and Imperial Chemical Industries, Ltd. June 22, 1934. 440,205.

AZO DYESTUFFS insoluble in water, manufacture.—I. G. Farbenindustrie. June 23, 1933. 440,207.

DYESTUFFS OF THE ANTHRAQUINONE SERIES, process for manufacture.—A. Carpmal (I. G. Farbenindustrie). June 23, 1934. 440,208.

4-NITROSO-DIPHENYLAMINE DERIVATIVES, manufacture.—I. G. Farbenindustrie. June 24, 1933. 440,344.

VISCOUS SOLUTIONS OF SALTS of anaesthetic substances with hydroxy-carboxylic acids, manufacture.—W. W. Groves (I. G. Farbenindustrie). June 27, 1934. 440,355.

CARBOXYLIC ACID ESTERS, manufacture.—W. W. Groves (Merri-mac Chemical Co.). June 28, 1934. 440,363.

CONDENSING MAGNESIUM VAPOURS, method and apparatus.—Magnesium Products, Inc. July 8, 1933. 440,274.

DODECAHYDROTRIPHENYLENE, manufacture and production.—

Coutts and Co. and F. Johnson (I. G. Farbenindustrie). Sept. 8, 1934. 440,285.

ALUMINIUM COMPOUNDS, preparation and use.—E. M. P. Spence, F. D. Spence, F. S. Abbot, and A. Sheppard, G. H. Riley and P. Spence and Sons, Ltd. March 16, 1934. 440,400.

PURE ALUMINA, manufacture.—Vereinigte Aluminium-Werke A.-G., and T. Goldschmidt, A.-G. Sept. 20, 1933. 440,486.

Applications for Patents

(December 12 to 18 inclusive)

ESTERS OF ALPHA METHACRYLIC ACID, manufacture.—Rohm and Haas A.-G. (United States, Dec. 14, '34.) 34896.

AZO DYESTUFFS, manufacture.—Soc. Anon. des Matières Colorantes et Produits Chimiques de Saint-Denis and R. Lantz. (France, Dec. 22, '34.) 35118.

ARSENIC COMPOUNDS of the naphthoquinone series, manufacture. Soc. of Chemical Industry in Basle. (Switzerland, Dec. 15, '34.) 34646.

AMINO-OXY-NAPHTHALENE-SULPHONIC ACIDS and azo dyestuffs therefrom, manufacture.—Soc. of Chemical Industry in Basle. (Switzerland, Dec. 18, '34.) 34648.

AMINO-OXY-NAPHTHALENE-SULPHONIC ACIDS and azo dyestuffs therefrom, manufacture.—Soc. of Chemical Industry in Basle. (Switzerland, Dec. 18, '34.) 34649.

MAGNESIUM, production.—W. H. A. Thiemann (I. G. Farbenindustrie). 34927.

RUBBER-LIKE CHLORO-2-BUTADIENE-1, 3 polymers.—United States Rubber Co. (United States, Dec. 22, '34.) 34967.

(December 19 to 24 inclusive.)

ANTIMONY FROM ALLOYS containing lead and/or tin, separation. American Metal Co., Ltd. (United States, Jan. 5.) 35451.

CARBONACEOUS MATERIALS, cleansing.—E. H. G. Aram, C. Machen, British Coal Distribution Co., and R. D. Hardy. 35320.

INDIGOID VAT DYESTUFFS, manufacture.—A. G. Bloxam (Soc. of Chemical Industry in Basle). 35426.

GASEOUS HYDROCARBONS, oxidation.—W. A. Bone, D. M. Newitt and Imperial Chemical Industries, Ltd. 35775.

CELLULOSE ETHERS, manufacture.—H. R. H. Brown, A. J. Watters and Imperial Chemical Industries, Ltd. 35629.

MONOAZO DYESTUFFS of the pyrazolone series, manufacture.—A. Carpmal (I. G. Farbenindustrie). 35395.

TETRAKIS-AZO DYESTUFFS containing copper, manufacture.—A. Carpmal (I. G. Farbenindustrie). 35396.

4-HYDROXY-NAPHTHOSYRIL and its substitution products, manufacture.—A. Carpmal (I. G. Farbenindustrie). 35714.

MONOAZO DYESTUFFS, manufacture.—A. Carpmal (I. G. Farbenindustrie). 35716.

UNSATURATED ETHERS, production.—I. A. Davies, K. I. Ross and Imperial Chemical Industries, Ltd. 35407.

From Week to Week

INTERNATIONAL TARI AND CHEMICAL PRODUCTS, LTD., 27 Finsbury Square, E.C.2, have increased their nominal capital by the addition of £1,000 in £1 ordinary shares beyond the registered capital of £1,000.

STATISTICS ISSUED by the United States Bureau of Mines show that the domestic production of petrol during November amounted to 40,461,000 barrels, against 41,862,000 barrels in October. Consumption during November was 35,956,000 barrels, against 41,401,000 barrels, while shipments amounted to 3,050,000 barrels, compared with 2,461,000 barrels in October.

PUBLIC SITTINGS OF THE ROYAL COMMISSION on the Private Manufacture of and Trading in Arms will be held on Wednesday, Thursday and, if necessary, Friday of next week. Evidence will be taken from Imperial Chemical Industries, Ltd.; Hadfields, Ltd.; Thomas Firth and John Brown, Ltd.; William Beardmore and Co., Ltd.; and Birmingham Small Arms Co., Ltd.

AMONG THE LARGE FIRMS which have indicated their readiness to pay an extra shilling a ton for their coal are Boots Pure Drug Co., Ltd., who at their Nottingham factories consume many thousands of tons a year. The company has stipulated that the whole of the extra shilling shall go to the miners themselves and that the arrangement shall automatically be cancelled in the event of a strike being declared.

A LARGE NUMBER of men have been engaged in the past few days at the Seaham Harbour works of the Coal and Allied Industries, Ltd., in preparation for the restart of the plant for the treatment of coal and oil under a special process. The plant has not worked for about three weeks following a fire which destroyed part of the works. It is now claimed that the plant is foolproof as far as it is possible to make it.

THE COUNCIL of the Association of British Chemical Manufacturers, at its meeting on January 9, gave consideration to the proposal for a voluntary increase in the price of coal on existing forward contracts. The council was, in principle, in sympathy with the proposals, and decided unanimously to advise its members that it was in favour of conceding an advance in the price of coal on the understanding that the extra money so obtained would be used solely for giving an increase in miners' wages, and that there would be no interruption of supplies.

THE DIRECTORS of B. LAPORTE, LTD., propose to capitalise £14,223 from the reserve fund and to distribute a special capital bonus of 10 per cent. to ordinary shareholders registered on January 13. Such shareholders will also be given the right to subscribe for one new ordinary £1 share at £3 10s. per share for every complete ten shares held. An additional 4,324 ordinary shares will be placed at the disposal of the directors for allotment to shareholders on a similar basis. The ordinary share capital will be increased by £32,770 to £175,000, and the total share capital to £326,000.

A DOUBLE SHIFT has been started at the Nethan Iron Works, of Frederick Braby and Co., Ltd., at Motherwell, where four puddling furnaces, a hall furnace and a forge rolling mill have been put on the night shift. A large order for about 800 tons of wrought iron has been received and will keep the works busy at this rate for at least two months. The Glasgow plant is also working at capacity. Four extra sheet mills were started recently and all are rolling very thin sheets. The revival of the sheet industry in the West of Scotland is a feature of the steel industry.

THE DIRECTORS of ZAN, LTD., Wheelock, entertained the employees at the works on January 3, to a social and supper. Mr. R. Gregory, on behalf of the employees, thanked the directors, Mr. R. B. and Mr. E. L. Hovey, for making that happy gathering possible. Mr. R. B. Hovey thanked Mr. Gregory and the staff for helping to make the social such a success, and especially those who, in their own time, had decorated the rooms. It had been another year of progress and endeavour. They had endeavoured to increase their sales and employ more people. For over six years the employees had been on full time, and the sales during 1935 were the highest in the history of the firm.

THE DIVISION of RESEARCH INFORMATION, National Research Council, Ottawa, has issued a report on evaporation losses from gasoline storage tanks under the influence of the sun's rays. The subject is of particular interest, in that official statistics show that in 1934 the amount of crude oil, gasoline, fuel oil, kerosene and lubricating oil in storage in the Dominion approximated 500,000,000 gals. Statistics of total losses sustained through evaporation from storage tanks are not available, but are recognised as being considerable. The report claims that two-thirds of these losses can be eliminated by reducing to a minimum the area of the tank exposed to the sun's rays and coating the surface with aluminium paint or other material having a high reflecting power. An even greater proportion can be avoided by insulation, which reduces to a minimum the variation of temperature over the surface of the tank. Finally, in large refineries more expensive systems of cooling and trapping the vapours can be employed to advantage. The report includes valuable data of the effect of the sun's rays on horizontal and vertical surfaces.

F. L. SMITH AND CO., LTD., are removing to-day (Saturday) from Victoria Station House to Horseferry House, Westminster, S.W.1. Their telephone number and telegraphic address will remain unaltered.

WE HAVE RECEIVED AN INQUIRY for back numbers of THE CHEMICAL AGE dated July 19, 1919, and June 30, 1931. Readers who have spare copies of these issues are invited to communicate with the publisher of THE CHEMICAL AGE, Bouverie House, 154 Fleet Street, E.C.4.

DAMAGE ESTIMATED at £1,500 was caused by fire which broke out on January 8 at the premises of Edward MacBean and Co., Ltd., manufacturers of oilskin clothing and oil-proofed fabrics, at Mary Street, Dundashill, Glasgow. The fire was confined to the curing shed and the first floor of the premises.

MISS HANNAH WILLIAMS, of Trebanos, was killed instantly on January 7, when she fell into a vat of boiling acid in the pickling department of a tinplate works at Pontardawe, Swansea Valley, where she was employed. Her sister, who was working with her, saw the tragedy. The body of Miss Williams was consumed by the acid.

THE ALBION CHEMICAL WORKS at Cornforth, Co. Durham, have been taken over by Henry Stobart and Co., Ltd., owners of the adjoining Thrislington colliery. The works, which include tar distilleries, were formerly owned by Dent, Sons and Co., Ltd. The head of the latter firm, Mr. Harry Dent, of Harrogate, has been presented by the employees with a companion set.

THE DECISION of R. W. Stewart and Co., Ltd., to close Elgin Bleachworks, was announced last week. Founded by the late Bailie Walker, the works are among the oldest of the kind in Fife. In the heyday of the linen industry, cloth bleaching and the finishing processes were carried on on an extensive scale in the works. Latterly, the staff of employees has been reduced to between 40 and 50, a few of whom are women.

IT IS REPORTED FROM BELGRADE that discoveries of great importance to the copper industry have been made near Zlot, in Eastern Serbia, Jugo-Slavia. Investigations conducted under the supervision of British and American specialists have revealed the presence of what is described as potentially one of the richest copper fields in the world. Moreover, the copper ore has relatively high gold and silver content. It is understood that discussions are proceeding for the installation of plant capable of producing about 40,000 tons of copper annually.

FOR THE FIRST TIME since the fourth quarter of 1931, and contrary to general expectation, the wages of north-east coast blast-furnacemen have been reduced at Middlesbrough. The average net selling price of No. 3 Cleveland pig iron for the last quarter of 1935 was certified on January 7, at 59s. 5.4d. per ton, as compared with 59s. 8.07d. per ton in the previous three months. Under the sliding scale arrangements the blast-furnacemen's wages are reduced by 0.25 per cent. for the present quarter, lowering the wages to 9.25 per cent. above the standard.

THE INSTITUTION OF PETROLEUM TECHNOLOGISTS, which has branches in Trinidad, Burma, Roumania, Iran, and South Wales, is establishing a branch in the north of England, to be known as the Northern Branch. The inaugural meeting of the new branch will be held at the Memorial Hall, Albert Square, Manchester, on January 24, at 7.30 p.m., when Sir John Cadman, president of the Institution, will deliver an address on "The Application of Science to the Petroleum Industry." A cordial invitation is extended to all who are interested in petroleum and its products.

THE MIDLAND CHEMISTS' COMMITTEE, representing the Chemical Society, the Birmingham University Chemical Society and the local sections of the Institute of Chemistry, the Society of Chemical Industry and the British Association of Chemists, will hold its annual dinner-dance at the Midland Hotel, Birmingham, on February 1. The principal guests will be Mr. W. A. S. Calder, president of the Society of Chemical Industry, and Mrs. Calder, Dr. R. H. Pickard, chairman of the Joint Chemical Council, and Mrs. Pickard.

THE FOLLOWING PAPERS were published by the National Physical Laboratory during December, 1935: "Remarks on the use of the logarithmic head correction in viscometry," by G. Barr; "Investigation of the behaviour of metals under deformation at high temperatures, Part I—Structural changes in mild steel and commercial irons during creep," by C. H. M. Jenkins and G. A. Mellor; "Iron of high purity," by F. Adcock and C. A. Bristow.

FURTHER DEVELOPMENTS are reported on the experimental borings for potash which are being carried on at the Hallein mine in Upper Austria. According to a statement made by Professor Georg Kyrle, these raise hopes that extensive potash deposits will

be discovered not very far beneath the Hallein salt beds. The National Geological Association, on the other hand, points out that whatever traces of potash may be found are not conclusive proof of any extensive deposits, and voices the opinion that there are no deposits worth exploiting below the salt beds. This view is also held by an expert sent by the Salzburg Provincial Government. A thick layer of chalk has been struck, and the Salt Mines Administration has ordered that the borings should only be continued through this for a further 250 metres. If any potash deposits are discovered, they would be capable of economical exploitation, as the beds could be approached by almost horizontal adits from the valleys.

ACCORDING TO A STATEMENT of the head of the Soviet Russian United Aniline Industry, the production in 1935 of aniline dyes in the Soviet Union reached 25,000 metric tons. For the production of these dyestuffs only domestic intermediates are used; of these 45,000 tons were produced in 1935. The development of the Society dye industry during recent years has permitted not only a complete satisfaction of the domestic demand for dyestuffs but also a considerable increase of exports of finished dyestuffs and intermediates. Only in the production of special dyes (indigo, indanthrene, and other dyes) is the Soviet dyestuffs industry still behind the foreign plants, since it does not possess the special equipment necessary for manufacture of these dyes. By the end of 1936, however, the necessary additions to the Soviet Russian plants should be completed and on the basis of various experimental work already partly completed, the new products will be manufactured. According to the published statement, the first deliveries of special dyestuffs was to take place at the end of 1935. In 1936 and 1937, production of these dyes is to be raised to a point where it will satisfy all domestic needs.

Forthcoming Events

LONDON

- Jan. 20.—Chemical Club. "Science and Crime." H. F. T. Rhodes. 8 p.m. 2 Whitehall Court, London.
Jan. 22.—Institute of Fuel. "The Cleaning of Coal Using Dense Media." Dr. R. A. Mott. 6 p.m. Burlington House, Piccadilly, London.

BIRMINGHAM

- Jan. 21.—Society of Chemical Industry (Birmingham and Midland Section). "Some Recent Progress in Inorganic Chemistry." Dr. W. Wardlaw. 7.30 p.m. University Buildings, Edmund Street, Birmingham.

BRISTOL

- Jan. 20.—Institute of Chemistry. "Technical Emulsification." Dr. W. Clayton. 5.30 p.m. University Chemical Department, Woodland Road, Bristol.

EDINBURGH

- Jan. 23.—The Chemical Society. "Some Recent Developments in Surface Chemistry." Professor E. K. Rideal. 8 p.m. North British Station Hotel, Edinburgh.

GLASGOW

- Jan. 21.—Society of Chemical Industry (Glasgow Section). "Applied Chemistry." Dr. L. A. Jordan. 7.30 p.m. Royal Technical College, Glasgow.

HUDDERSFIELD

- Jan. 21.—Society of Dyers and Colourists (Huddersfield Section). "Hosiery Dyeing and Finishing." H. L. Long. Huddersfield.

LEEDS

- Jan. 20.—Institute of Chemistry (Leeds Area Section). "The Industrial Uses of Nitrogen." M. P. Applebey. 7.30 p.m. University, Leeds.

LIVERPOOL

- Jan. 22.—British Association of Chemists (Liverpool Section). "Micro Methods in Criminal Investigation." W. Doran. 7.30 p.m. University, Liverpool.

MANCHESTER

- Jan. 24.—Institution of the Rubber Industry (Manchester Section). Dinner-Dance. "The Manchester." Ltd., Manchester.
Jan. 24.—Institution of Petroleum Technologists. Inauguration of Northern Branch by Sir John Cadman. "The Application of Science to the Petroleum Industry." 7.30 p.m. Memorial Hall, Albert Square, Manchester.

SWANSEA

- Jan. 21.—Institute of Metals (Swansea Section). "Modification of Alloys." Dr. A. L. Norbury. 6.30 p.m. Y.M.C.A., Swansea.
Jan. 24.—Society of Chemical Industry (South Wales Section). Joint meeting with local sections of the Institute of Chemistry, Institute of Metals, Institute of Petroleum Technologists, Chemical Society and the University College of Swansea Chemical Society. "The Role of Cellulose Acetate in Modern Plastics." Dr. V. E. Garsley. 7 p.m. Hotel Metropole, Wind Street, Swansea.

Company News

Distillers Co.—An interim dividend of $7\frac{1}{2}$ per cent., less tax, is announced on the £10,630,962 ordinary capital. The half-yearly payment has been maintained at this level for many years. In the past two years the final payment has been $12\frac{1}{2}$ per cent., making 20 per cent.

"Shell" Transport and Trading Co.—The directors have decided not to declare an interim dividend on the £24,121,361 of ordinary capital in respect of 1935. On November 19, 1935, the directors announced that they had decided to defer their decision as to an interim payment. No interim payment was made in respect of 1934, but $12\frac{1}{2}$ per cent. was distributed for the year, against $7\frac{1}{2}$ per cent. for 1933. The last interim dividend was in 1930, when 10 per cent. was paid, followed by a final of $7\frac{1}{2}$ per cent.

British Celanese, Ltd.—It is announced that the directors have decided to pay on January 31, a half-year's dividend on the 7 per cent. first cumulative preference shares, of which £2,000,000 are outstanding, bringing the dividends paid on this class of share up to October 31, 1934. Payment will be made to holders registered on January 15, 1936. The last payment of arrears was made on October 31 last, when a full year's dividend was paid. Dividends on the $7\frac{1}{2}$ per cent. participating second cumulative preference have been paid up to April 30, 1930.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette, etc.

Notice of Dividend.

THE T. AND R. W. BOWER (ILLINGWORTH) CARBONISATION CO., LTD., 10 Booth Street, Bradford, Yorks. First and final dividend, 10.65d. per £, payable Jan. 17, 1936, at the office of the liquidator, 3 Frederick's Place, Old Jewry, London, E.C.2.

New Companies Registered

British Gas and Torch Co., Ltd., 10 Victoria Street, S.W.1.—Registered January 13. Nominal capital £2,000. Producers, importers and exporters of and dealers in all kinds of gases and gaseous fuels and other fuels of all kinds, chemicals, dyewares and their auxiliaries and derivatives, disinfectants, chemical and colouring compositions, etc. Directors: F. T. Hare, J. Jensen, Fdk. C. T. Lane.

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Egypt.—The Department of Public Health, Cairo, is calling for tenders, to be presented not later than 10 a.m., on March 16, for paints, enamel, soft soap, zinc oxide, varnishes, matches, glass, soda, etc. Tenders (accompanied by samples) will be received by the Director of Stores, Department of Public Health, Cairo. Copies of the specifications and conditions of tender are available for purchase at the office of the Chief Inspecting Engineer to the Egyptian Government, 41 Tothill Street, S.W.1. Local representation is essential, and the Department of Overseas Trade, 35 Old Queen Street, London, S.W.1, is prepared to furnish firms desirous of tendering for the supply of material of United Kingdom manufacture, and not represented in Egypt, with the names of merchant houses with Egyptian connections who may be willing to handle tenders on their behalf. (Ref. 26029/36.)

Books Received

- Boiler Feed Water Treatment.** By F. J. Matthews. London: Hutchinson's Scientific & Technical Publications. Pp. 256. 12s. 6d.
Science Masters' Book. Series II. Parts I and II. London: John Murray. Pp. 273 and 252. 7s. 6d. each.
Chemical Discovery and Invention in the Twentieth Century. By Sir William A. Tilden. London: George Routledge and Sons, Ltd. Pp. 492. 15s.

Official Publications Received

- Water Pollution Research.** Summary of Current Literature. London: H.M. Stationery Office. Pp. 36. 2s.

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